SELECTED FACTORS DETERMINING SECONDARY SCHOOL TEACHER DEMAND IN KENYA: TRENDS, EFFECTS AND PROJECTIONS

DAVID KURIA WAMUKURU

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DECLARATION AND RECOMMENDATION

Declaration

I declare that this thesis is my original work and that it has not been presented for a degree or any other award in this or other university.

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David Kuria Wamukuru, M.Ed

Reg. No. ED 15/0138/05 **Date**

Recommendation

This thesis has been submitted for examination with our approval as University supervisors.

_____ _____

Dr. Moses W. Ngware, PhD **Date**

Research Scientist,

African Population and Health Research Center

_____ _____

Dr. Washington A. Ochola, PhD **Date**

Department Agricultural Education and Extension,

Egerton University.

DEDICATION

I humbly dedicate this work to God the Almighty for enabling me to accomplish this task. To my late father, Paul Wamukuru Kibunja for his love, encouragement and support, to my mother, Janet Wangeci Wamukuru, to my wife Ebby Imali, my daughter Daisy Janet Wangeci and my Son Elon Paul Wamukuru. To all my brothers: Dr. Henry K. Wamukuru, Daniel Kimani, Samuel Kanyiha, Isaac Khungu, Japheth Mwangi, Charles Kariuki and the Late Stephen Gathiri and their families for their love and support.

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ABSTRACT

Teachers are an important human resource in the teaching and learning processes and their training and utilization therefore requires critical consideration. The education sector in Kenya faces many challenges, including escalating teacher wage bill, teacher shortages in schools alongside surpluses in the labour market, inequitable distribution and inefficient utilization of teachers. There is therefore the need for a framework for projecting and relating demand to the supply in order to avoid imbalances in the future. The purpose of this study was to establish the trends and effects of factors that determine the demand for trained secondary school teachers in Kenya. The study also aimed at developing a model that embraces a framework for projecting future teacher demand. A cross-sectional research design was adopted in this study. The population of this study included all the 4236 public secondary schools in Kenya in 2007, graduate and diploma teachers who have been teaching in the public secondary schools in Kenya between 1990 and 2007 and sixteen Teacher Service Commission (TSC) provincial staffing officers. Simple random sampling was used to select 351 public secondary schools. Data on all graduate and diploma teachers who have been teaching in public secondary schools between 1990 and 2007 were obtained from the TSC records. A purposive sample of eight provincial staffing officers at the TSC Headquarters was also included. The data were collected by use of two document analysis profoma and one interview schedule. Data analysis was done using descriptive statistics, trend data analysis, Pearson's product moment coefficient and Dagostino Pearson test, Shapilo-Wilk W test for normal data and Poisson regression. The study established that the main factors determining secondary school teacher demand in Kenya include: number of teachers on duty, secondary school enrolment, class size and number of newly employed teachers each year. The study also concluded that if the current trends in teacher demand factors in public secondary schools are maintained, there will be a shortage of eight teachers, on average, at the school level and a shortage of 79,901 teachers at the national level in 2030. The study developed a framework for projecting secondary school teacher demand as well as generating pertinent information on the factors related to secondary teacher workforce dynamics and its planning. By understanding these factors and their plausible future trends the policy makers, including the Ministry of Education (MoE) and the Teachers Service Commission (TSC) would take proactive policy reforms that would help reduce the level of teacher shortages in secondary schools in Kenya.

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LIST OF ABBREVIATIONS AND ACRONYMS

a	Constant
a_1	Average teacher salary
a_2	Teacher training places
a_3	Existing teacher workforce
a_4	Graduating teachers
a_5	Gender as a dummy variable
bx_1	Number of teachers on duty
cx_2	Student enrolment
dx_3	PTR
ex_4	Number of Classes
fx_5	Average class size
gx_6	Number of streams
hx_7	Number of teachers employed
ix_8	Average teacher workload
jX_9	Government policy
BA	Bachelor of Arts
B.Ed	Bachelor of Education
B.Sc	Bachelor of Science
CAM	Comprehensive Attrition Model
DIT	Directorate of Industrial Training
ε	Error term
EFA	Education for All
FPE	Free Primary Education
FTE	Full-Time Equivalent
GDP	Gross National Product
GoK	Government of Kenya
HIV/AIDS	Human Immune Deficiency Virus/Acquired Immune Deficiency Syndrome
KCPE	Kenya Certificate of Primary Education
KNUT	Kenya National Union of Teachers
KUPPET	Kenya Union of Post-Primary Education Teachers
LEA	Local Education Agency's

Ln (y)	Linear Log y
MOEST	Ministry of Education Science and Technology
NEA	National Education Association of the United States
OECD	Organisation for Economic Co-operation and Development
PE_t	Projected Enrolment in year t
PCI_{-2}	Disposable income per capita (adjusted for inflation) lagged 2 years
PGCE	Post Graduate Certificate in Education
$PPTR_t$	Projected Teacher-Pupil Ratio in year t
RPEP	Rural Professional Education Program
$SCENR$	Secondary enrolment.
$SCTCH$	Number of secondary teachers
$SGRANT_{-3}$	Local education revenue receipts form state sources per capita (adjusted for inflation) lagged 3 years.
TSC	Teachers Service Commission
y	Teacher Demand

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

There is consensus in literature that secondary education is now the fastest growing segment of the education sector (SEIA 2001; UNESCO 2001; Mulkeen *et al.*, 2005; World Bank 2005; Di Gropello, 2006; World Bank, 2007). Movement away from seeing primary education as the terminal level of education towards policies that envision widespread completion of lower and upper secondary as the goals of education system development are well underway in many Latin American, African and Southeast Asian countries (De Ferranti, 2003; World Bank 2005). The change from the long-standing policy focus on primary education only came in 1995 when the donors' strategic focus began to shift to "basic" education—which includes primary and lower secondary. Students today need secondary education to provide them with the technical, academic, and life skills to contribute to the economic prosperity of their countries (World Bank, 2005).

Teachers constitute the core of the education system and their importance in student performance has been widely confirmed by many studies (Rivkin, Stephen, Ertik & John, 2000). Thus teachers are an important resource in the teaching/learning process and their training and utilization therefore requires critical consideration (Ministry of Education Science and Technology, 2005a). In recent years an increasing number of studies have expressed concern about current and prospective teacher shortages in many countries. According to Santiago (2002) severe shortages currently exist, and there is a gap between demand and supply of teachers needed to ensure effective teaching in many countries. Teacher shortages have therefore, become a major concern to educational authorities and should be addressed continuously by policy makers.

Qualified teachers in both the developed and developing world are quickly becoming the hardest segment of the teaching profession to attract and retain and are the most expensive to educate (World Bank, 2005). Research also indicates the often extensive employment of under-qualified or contract teachers in secondary schools operating outside of the public system (Lewin, 2005; UIS, 2006). A study by Moore, Destefano, Terway and Balwanz, (2008) showed that teacher recruitment, retention, and deployment are insufficient and inefficient. However, relatively few studies have analyzed the shortfall of qualified teachers

as an impediment to growth in the system, particularly for secondary education (Scott, 2001; Lewin, 2002). Literature suggests that there have been few, if any, interventions to improve recruitment, retention and retraining of secondary school teachers that have yielded dramatic, positive results (Lewin, 2002; World Bank, 2005).

In Kenya, weaknesses in human resource planning has affected training and deployment of teachers and thus distorted their distribution and utilization. Consequently, there exists an unbalanced distribution of teachers, teacher shortages, teacher surplus and inefficient utilization of teachers (MOEST, 2005b). This could be an indication of the absence of a framework in determining the demand for teachers. Most teachers prefer to work in urban, peri-urban and high potential areas where social amenities are available (MOEST, 2005a). Thus the current policy of recruiting teachers where vacancies exist is aimed at redressing the uneven distribution of teachers.

Since June 2003, the Teachers Service Commission (TSC) has been carrying out a balancing exercise to move teachers from overstaffed areas to understaffed areas but this exercise has faced major resistance (MOEST, 2005a). Teachers are reluctant to move from their already established stations to remote areas, places considered hardship areas or from rural to urban or vice versa. For this reason, hardship and remote areas continue to suffer teacher shortages. Alternative modes of deployment for appropriate utilization of teachers, therefore, need to be explored and implemented. Some scholars have recommended that the monopoly given to the TSC be dismantled and allow the formation of efficient and independent employment boards to deal with teachers recruitment, promotion and terms of service (Institute of Policy Analysis and Research (IPAR), 2008). Such a move would make teaching profession more efficient (Abagi & Olweya, 1999) and responsive to the demands of the dynamic education system.

Teacher demand in Kenya, has therefore, attracted the current public debate with school principals and Kenya National Union of Teachers (KNUT) insisting that teacher shortages are acute in secondary schools, while on the other hand the Government argues that most districts are overstaffed and there is need to address the issue of teacher deployment and distribution before recruiting new teachers (Education International, 2005). As a result in 2005, MOEST requested District Education Board Officials to asses the staffing levels in all schools and advice the Ministry on the actual teacher shortages (Education International, 2005). The

Kenya National Union of Teachers (KNUT) even demanded that the Government declare the shortage of teachers a national disaster (Muriithi, 2010). According to KNUT the goals of Vision 2030 in education will not be achieved if the teacher shortage is not addressed urgently.

Optimal staffing in schools is a factor of pupil enrolment, number of subjects and subject combinations, number of hours taught per week, number of streams and teacher involvement in administrative and other extracurricular assignments. These have to be taken into account when using the standard pupil - teacher ratio (PTR) for determining school staffing levels. While the Government puts priority on the wage bill as a major factor, teachers, through KNUT and the school principals, lay strong emphasis on the teacher welfare and workload in arguing their case for increased staffing. While both sides of the argument need to be considered in settling this debate, more emphasis should be placed on understanding the effect of critical factors related to the demand and supply of secondary school teachers in relation to past and projected future trends. These are the essentials of teacher demand and supply dynamics. These dynamics must also be compared to those prevailing in private schools and other public service employment portfolios.

Teacher shortages are frequently viewed as impacting negatively on quality of teaching and learning, and an understanding of the factors influencing these shortages is absolutely crucial to educational planners and policy makers. Teacher shortages seem to be associated with a set of factors that reduce supply and increase demand. The most commonly cited factors include decline of the overall attractiveness of the teaching career, relative to other careers. This decline is closely associated with the teacher salaries, which have remained low, relative to those of other occupations (Santiago, 2002). For Example, on average the starting salary of a secondary school teacher in Kenya is 70% of average starting salary of public servant (GoK, 2008). Another factor explaining the existence of teacher shortages is associated with increased retirement rates. Studies have shown that many developed countries including USA, England and Germany have an aging teaching force (Eurydice, 2002). The situation is similar in Kenya where teacher recruitment has been minimal despite the increase in supply of teachers graduating from universities and other teacher training colleges; and the ever spiralling need for secondary school teachers occasioned by increasing enrolment levels. Major shortages in 1995 were experienced in science subjects including Chemistry, Physics

and Mathematics while there was teacher surplus in other subjects especially in social sciences including geography, history and CRE (MOEST, 2005b; Delloitte & Touche, 1995). However, by 2003, teacher surpluses indicated in geography, history and CRE had disappeared and in their place came shortages in these subjects (TSC, 2005). The situation remained the same in 2009 (TSC, 2009).

One of the major challenges facing the education system in Kenya is the need for more teachers against a constrained budget. By 2005, the teacher wage bill absorbed eighty four per cent of the MOEST budget (MOEST, 2005b). This has led to calls for containment or reduction of the wage bill so that savings can be made and used in funding other essential educational inputs. This factor had earlier led to the freeze of employment of teachers by the TSC between 1998 and 2000. Prior to 1998 the TSC had been recruiting teachers from the universities and other colleges and posting them to various schools in the country. However the Government changed this practice of automatic recruitment of all graduate teachers with effect from 1st July 1998. This was done in line with the civil service reform programme, which aimed at staff reduction in the civil and the teaching services (Government of Kenya (GoK), 1999). Teacher rationalization programme is part of this wider programme of reforms. From 2001, the Government implemented changes in the teacher recruitment policy, where teachers in secondary schools are recruited on the basis of vacancies in various secondary schools and the ability of the Government to pay.

However the freeze in teacher recruitment did not succeed in reducing the teachers wage bill. Indeed the wage bill experienced an upward trend despite the efforts. As shown in Figure 1, the teachers wage bill doubled in ten years from 1997 to 2007. Despite the reduction in the number of teachers employed the wage bill has been increasing due to annual salary increase and campaigns by teachers unions especially KNUT and Kenya Union of Post-Primary Education Teachers (KUPPET) bargaining for salary increase for teachers. In 1997 KNUT negotiated for teachers increase with the Government under collective bargain agreement which awarded teachers a salary increase of 200%, the salary increase has been implemented.

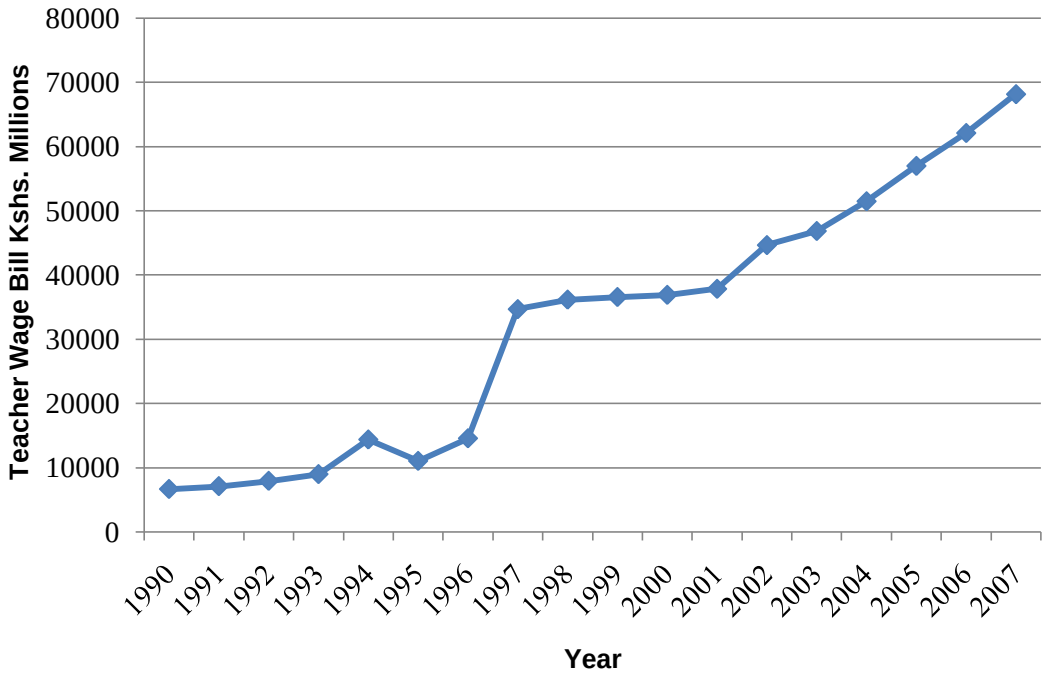

Figure 1: Teacher Wage Bill 1990 to 2007

The current staffing norm in secondary schools in Kenya was brought about by a major policy reform implemented in 1984 leading to the use of Curriculum Based Establishment (CBE) which specified a minimum teaching load of 27 lessons per week (MOEST, 2005b; TSC, 2007). The current norm however does not specify a minimum or a maximum class size and is not sensitive to regional variations. Furthermore, the CBE does not take into account the Arid and Semi-Arid (ASAL) regions. Relying strictly on the CBE may lead to small class sizes and low student-teacher ratio, hence under utilization of teachers (MOEST, 2005b; Wamukuru & Muthaa, 2010). Despite the norm, on average teachers handle a teaching load of 22 lessons, an indication that they are underutilized. Based on the CBE, there was a teacher shortage of 10,287 teachers in 2007 (TSC, 2007). Based on the staffing norm, there was an estimated teacher shortage of about 6,226 teachers in 2005 (MOEST, 2005b). In the year 2009 teacher shortage in secondary schools had reached 23,291. Major shortages in 1995 were experienced in science subjects including Chemistry, Physics and Mathematics while there was teacher surplus in other subjects especially in social sciences including geography, history and CRE (MOEST, 2005b; Delloittee & Touche, 1995).

The majority of secondary school teachers are trained at public and private universities and diploma colleges and are required to specialize in two teaching subjects upon graduation

(MOEST, 2005a). Within the public universities and diploma colleges, teacher education programmes have the largest student enrolment. During the 2007/2008 academic year compared to other programmes the Bachelor of education students were leading in proportion in Kenyatta University (48.3%), Maseno ((40%), Moi (28.4%) and Egerton Universities (28.7%). At the University of Nairobi, the B.Ed students (12.1%) were third in proportion after Bachelor of Arts and Bachelor of Sciences. The number of Bachelor of education students increased from 11,693 in 2000 to 21,636 in 2007 (Gok, 2008). The large increase in the number of B.Ed (Arts) graduates is partly as a result of the introduction of this proramme in most of the public universities and university colleges in the country. The 1990 public universities double intake of the last A-level and the first 8-4-4 group further increased the enrolment with introduction of these programmes at Egerton University's Laikipia Campus and Moi University's Eldoret and Maseno campuses. Despite the increasing proportion of B.Ed (Arts) graduates, there still remains a large gap between their total output and the vacancies available for them. Also within the B.Ed (Arts) programme, there was an oversupply of graduates in some subjects and a shortfall in supply in other subjects (Delloittete & Touche, 1995).

Student enrolment in secondary schools has been experiencing a steady growth, increasing from 618,500 in 1990 to 1180300 students in 2007, an increase of 90.8% percent (GoK, 2007). The number of secondary schools also increased from 2,557 in 1990 to 4236 in 2007, an increase of 65.7% percent. However the number of teachers increased at a lower rate of 58 percent from 28056 in 1990 to 44305 secondary school teachers in 2007. The fact that the number of teachers has been increasing at a lower rate than the rate of increase in number of schools and student enrolment could negatively affect the quality of teaching and learning in public secondary schools.

The introduction of Free Primary Education (FPE) in 2003 required that the education system train and retain sufficient number of well qualified teachers, not only at the primary level but in secondary school level as well (Nilsson, 2003). The introduction of FPE saw an increase in enrolment by more than 1.5 million in the primary schools in 2003 (Saitoti, 2005). Levels of teacher demand in secondary schools in Kenya are likely to be greatly overstretched by the introduction of Free Secondary Education (FSE) in January 2008. This indicates the need for a framework of projecting teacher demand in order to avoid crisis as the output of FPE enter

secondary while FSE attract more enrolments in this level. In the year 2004 for example, a total of 657,747 candidates sat the Kenya Certificate of Primary Education (KCPE) up from 587,961 candidates in the previous year, reflecting an increase of 12 per cent, the highest increase in the previous ten years (Mkwale, Mutai, Murigi & Bartoo, 2004). The transition rate from primary school level to secondary school level has also been increasing over the years. In 2007 the transition rate was 47.3% up from 41.7% in 2002 (Republic of Kenya, 2008).

It is also important to account for teacher attrition due to death from Human Immune Deficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS). The spread of HIV/AIDS has been having devastating effects on teachers in developing countries. The pandemic greatly reduces the capacity of the system by increasing teacher attrition and absenteeism (World Bank, 2005). It also saps the system's energy by imposing additional demands on teachers as they provide support for ill students and students with ill family members. In some countries in Africa, the number of teachers lost due to HIV/AIDS each year has been close to half the number trained for each year (Nilsson, 2003). In Kenya, on average, 10 teachers die from the disease each week (American Federation of Teachers, 2001). According to a study by Njeru and Kioko (2004) in Kenya, overall teacher death increased from 1,216 in 1997 to 2,133 in 2003 due to HIV/AIDS. There is also high teacher attrition due to other causes including retirement, resignation and dismissal among other reasons. The high rate of teacher attrition, calls not only for quick replacement but also an in-depth analysis to determine and predict its effect on demand in order to safeguard against shortages.

A clear teacher demand framework will be necessary not only to rationalize teacher utilization but also to guide in meeting the targets for MDGs in education and Kenya's Vision 2030. The vision for the education sector for 2030 is "to have globally competitive quality education, training and research for sustainable development". To achieve this vision, key strategic areas, namely, access, quality, equity, science, technology and innovation have been identified for support based on their impacts on the economic, social and political pillars (Republic of Kenya, 2007). Kenya recognizes that the education and training of all Kenyans is fundamental to the success of the vision and therefore the education sector is expected to provide the skills that will be required to steer Kenyans to the economic and social goals of

Vision 2030. For the vision to be realized, a number of challenges facing the education sector at the secondary school level need to be addressed. The transition rate from primary to secondary school was estimated at 60 per cent, which was an indication of a rising trend. However; the rate was below that of developing countries on the road to industrialization and those with middle income status. Further, access to secondary education is hindered by the high cost of education, and the low participation of private providers of post-primary education. In recognition of the problem, the Government in 2007 announced tuition fee relief for the initial years of secondary education. With the imminent rise in the number of students completing primary and secondary education as a result of free primary and free secondary education, preparations will have to be made to also expand education in the secondary education sector. In line with Vision 2030 the Government plans to construct 560 new secondary schools and recruit more teachers in this level. In order to realize the planned strategies in secondary education sector in line with Vision 2030 and MDGs in education in Kenya, it will be necessary to have a clear framework based on teachers demand model to guide in teacher recruitment and deployment.

The selected factors that influence demand for secondary school teachers at the school level that were investigated in this study included; the number of teachers on duty, student enrolment, Pupil Teacher Ratio (PTR), class size, number of classes, number of streams, teacher workload, number of teachers employed and Government policy. These factors were considered representative of the critical driving forces behind trained teacher availability and decisions as well Government policies on secondary school teacher employment (Boe, 1990; Delloittete & Touche, 1995; MOEST, 2005b).

1.2 Statement of the Problem

The absence of a reliable teacher demand model in Kenya has led to weaknesses in planning teacher training and recruitment (MOEST, 2005a). The secondary school teacher labour market, thus, faces many challenges including, escalating teacher wage bill, teacher shortages that occur alongside teacher surpluses, inadequate teacher distribution and inefficient teacher utilization (MOEST, 2005b; IPAR, 2008). This could be an indication of the absence of a framework for determining the factors affecting teacher demand and a lack of understanding of the way these factors influence teacher demand. The introduction of Free Secondary Education (FSE), together with the expected influx of the FPE graduates into secondary

schools, and Kenya's Vision 2030 in secondary education require an in-depth analysis, to be able to determine and to project their effects on demand for teachers in order to safeguard against shortages and expensive surpluses. There is the need therefore to understand the effects of the factors determining demand for secondary school teachers and to develop a model to project future secondary school teacher demand in Kenya.

1.3 Purpose of the Study

The purpose of this study was to establish the trends in the secondary school teacher demand factors and effects of the selected factors on the demand for trained secondary school teachers in Kenya. The study also aimed at developing a model that embraces a framework for projecting future secondary school teacher demand.

1.4 Objectives of the Study

Specifically the study sought to:

i. Establish the trends of secondary school demand factors in Kenya between 1990 and 2007.
ii. Determine the effects of selected factors on the demand for trained secondary school teachers in Kenya in 2007.
iii. Develop a model for projecting future demand for trained secondary school teachers in Kenya.

1.5 Research Questions

The following research questions guided the study:

i. What were the trends of the secondary school demand factors in Kenya between 1990 and 2007?
ii. What were the effects of selected factors on teacher demand in secondary school teachers in Kenya in 2007?
iii. What is the projected future demand for trained secondary school teachers in Kenya?

1.6 Significance of the Study

This study is significant in that it yielded useful information for policy makers, educational planners, administrators, economists and other stakeholders on the magnitude of teacher demand in secondary schools in Kenya. The results of the study provide important information about the teacher labour market which may guide educators, policy makers,

planners and other stakeholders in making relevant teacher staffing and rationalization decisions. The study provides the policy makers, Ministry of Education (MOE) and other stakeholders with information on the most important factors that determine the demand for teachers in the country which would guide future decision making regarding teacher workforce. The study also developed a model for use by policy makers in projecting future demand for secondary school teachers in Kenya. The study aimed at bridging the literature gap in the area of secondary school teacher demand. The study also forms a basic source of reference for universities, educators, policy makers and other interested parties on factors that determine demand for teacher together with their future projections.

1.7 Assumptions of the Study

This study made two assumptions;

i. That proper and updated records on teachers between 1990 and 2007 were available at the TSC headquarters
ii. The student enrolment was an indicator of population trends and so the effects of population changes on the demand for teachers were based on enrolment levels.

1.8 Scope of the Study

The study was confined to information on trained secondary school teachers teaching in public secondary schools between 1990 and 2007. The selected factors that were investigated in this study included the number of teachers on duty, student enrolment, Pupil Teacher Ratio, class size, number of classes, number of streams, teacher workload, number of teachers employed and Government policy. These factors represent the critical drivers of teacher need at the school level and teacher employment policies.

1.9 Limitations of the Study

The study had the following limitation:

Ad hoc changes in policy involving teacher training, recruitment, deployment and transfers could affect the trends and projections of the demand for teachers and their determinants in non-systematic manner. The use of data over many years to bring out the trends was intended to reduce the effect of these non-deterministic changes on the trends and projections established.

1.10 Operational Definition of Terms

For the purpose of this study, the following terms were taken to have the following meanings:

Average Teacher Salary: The mean monthly remunerations given to teachers in compensation to their service. It includes the basic salary, house allowance and other financial entitlements average for all teachers across different job groups

Diploma Teacher: Trained secondary school teacher who is a holder of a Diploma in Education from a diploma teacher training college or university.

Effective Teachers Demand: The number of graduate and diploma teachers required in secondary schools. In this study it refers to the actual level of understaffing at the school level in terms of number of teachers needed.

Graduate Teacher: Trained secondary school teacher who is a holder of a Bachelor of Education Degree or Post Graduate Diploma in Education (PGDE) from a recognized university.

MOEST Budget: The fiscal allocation to the Ministry of Education Science and Technology from the treasury for the annual recurrent and development expenditure.

Opportunity for Teacher Employment: The number of vacant positions in the secondary school teacher labour market by subject category.

Pupil Teacher Ratio: The number of pupils enrolled in a secondary school compared to the number of teachers in that school.

School Location: The geographical area of a secondary school in Kenya which include province, district, rural and urban.

Structural Elements: Policy issues on the education system that may affect demand and supply of secondary school teachers.

Student Population: The total number of students enrolled in a secondary school.

Teacher Labour Market: Refers to the prospective career opening in the economy ready to absorb new entrant trained teachers.

Teacher Retirement: Refers to the number of teachers that leave teaching profession after attaining their retirement age.

Teacher Supply: The number of trained teachers produced from universities and diploma teacher training colleges.

Teacher Training Places: The number of available places for teacher training by subject available in Universities and Diploma Teacher Training Colleges.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this section a review s conducted of literature related to legal and policy framework on teacher demand and management in Kenya; factors influencing demand for teachers; teacher demand in developed and developing countries; teacher demand in Kenya; models and theories used to study teacher demand and conceptual framework.

2.2 Legal and Policy Framework on Teacher Demand and Management in Kenya

Education and training in Kenya is, today, facing various challenges that have negatively impacted on the economic development. Some of these challenges relate to access, equity, quality, relevance, efficiency in the management of educational resources, cost and financing of education, gender and regional disparities, and teacher quality and teacher utilization (IPAR, 2008). Various policy documents (GoK, 2003; MOEST, 2005a, 2005b) acknowledge these challenges but no serious policy solutions has been put in place to address these challenges (IPAR, 2008). There is need to provide a policy framework for the education and training sector to meet these challenges. Over the years, scholars and research and policy organizations have recommended reforms in the legal framework in education (Abagi & Olweya, 1999; IPAR, 2008). They continue to argue that such reforms would form a good foundation for the development of relevant institutions and structures that will make education relevant and efficient.

It is against this background that the Ministry of Education, Science and Technology (MOEST) organized a National Conference on Education and Training in November 2003 with an objective of building consensus on policies and strategies in education and training for improved performance in the sector (MOEST, 2003). The conference mandated the MOEST to develop a new policy framework for the education sector. Regarding teacher resource, the Conference recommended that, the MOEST should carry out a teacher distribution study that would lead to a policy on staffing norms in all areas of the country (MOEST, 2003). Vision 2030 which aims to turn Kenya to a middle class economy by the year 2030 is an attempt to deal with these challenges.

Before 1984, staffing in secondary schools was based on the norm of 1.5 teachers per class. A major policy reform implemented in 1984 led to the use of current Curriculum Based Establishment (CBE) which specified a minimum teaching load of 27 lessons per week (MOEST, 2005b). Despite the norm, on average teachers handle a teaching load of 22 lessons, an indication that they are underutilized. The current norm however, does not specify a minimum or a maximum class size and are not sensitive to regional variations. Relying strictly on the CBE may lead to small class sizes and low student-teacher ratio, hence under utilization of teachers (MOEST, 2005b).

The teacher resource is one of the most important inputs into the education system and, therefore, efficient utilization of teachers is critical in the overall teacher management (MOEST, 2005a). The distribution and utilization of the teacher resource in the Kenyan education system therefore, has major equity implications. There is a wide variation in the number of teachers relative to the number of pupils across provinces, districts and zones that may imply that teacher distribution is not in line with school needs (MOEST, 2003; MOEST, 2005b).

The Teachers Service Commission Act of 1967 established a single employer service and unified terms of service for teachers (MOEST, 1967). It is the employer of teachers for primary and secondary education; teachers training colleges, middle level colleges and institutes. TSC ensures the maintenance of professional ethics and discipline in accordance with established code of regulations. It is mandated to register, recruit, transfer, promote and discipline teachers.

From 1967 to 1997 the TSC used centralized supply driven policy in teacher recruitment whereby all teaching graduates from universities and teacher training colleges were employed by the Government. All the recruitments were done at the TSC headquarters. However, this policy changed in 1997, following the Government freeze on employment of civil servants, including teachers, due to budgetary constraints. Since the year 2001, the TSC has been recruiting teachers to replace those who leave the teaching service through natural attrition. The new policy on teacher recruitment in place since 2001 is decentralized and is expected to be demand-driven. Vacant secondary school teaching positions by school and subject are advertised and qualified candidates are expected to apply directly to the schools. The

interviews are conducted by the school BOGs who then shortlists the candidates by order of merits and forward the details of the successful candidate to the TSC for recruitment. However, teacher management problems have been noted where unplanned teacher recruitment for public schools has affected deployment of teachers and thus distorted their distribution (MOEST, 2005a). As a result, there exists an unbalanced distribution of teachers across the country (TSC, 2005; MOEST, 2005a).

The current policy of recruiting teachers where vacancies exist is aimed at redressing the uneven distribution of teachers. Although the new recruitment policy is expected to be demand-driven, the actual demand at the school level is usually not fully met since the Government does not have enough funds to recruit all the required teachers. Only teachers leaving the profession through natural attrition are replaced an indication that the new demand driven policy is not being utilized. Furthermore, the decentralised policy of recruiting teachers at the school level has been criticised of inefficiencies and corruption. According to a study by Wanjala and Okinda (2005), the current staffing trends in secondary schools are not satisfactory. The recruitment panel members' capacity to effectively and efficiently perform the recruitment exercise at the school level was also noted to be limited (Wanjala & Okinda, 2005).

A study by Aloo, Simatwa and Nyang'ori (2011), in secondary schools in Nyando District, established that there was disparity in distribution of subject teachers with some being evenly distributed and others being unevenly distributed contrary to the aim of the decentralized teacher recruitment policy. However, distribution of teachers across schools was found to have improved.

The TSC has been carrying out a balancing exercise to move teachers from overstaffed areas to under staffed areas, but this exercise faces major resistance and as a result, hardship and remote areas continue to suffer serious teacher shortage (TSC, 2007; TSC, 2009). The new recruitment policy is silent on recruitment of teachers to hardship and remote areas. The policy requires that a newly recruited teacher remains in the same school for a period of at least five years before seeking a transfer (TSC, 2002). While this requirement tries to solve the problem of teacher distribution caused by teacher transfers, it may discourage teachers from seeking recruitment in hardship areas. Alternative modes of deployment for appropriate

utilization of teachers, therefore, need to be explored and implemented. The alternative model would better be underpinned by scientific framework for understanding teacher demand factors and projections.

Some scholars have recommended that the monopoly given to the TSC be revisited and allow for the formation of efficient and independent employment boards to deal with teachers recruitment, promotion and terms of service. Such a move will reduce the Government recurrent expenditure in education and make teaching profession more efficient (IPAR, 2008; Abagi & Olweya, 1999). According to them educational reform programmes should be informed by systematic policy research and analyses, and not political decrees. Continuous and systematic policy oriented research and analysis should be put in place to guide policy formulation and implementation. They also recommend that policy formation and implementation be guided by professionalism and vision based approach.

Lack of clear policy guidelines in many countries have resulted to imbalanced teacher demand and supply. For example, survey conducted by Education International in six Anglophone countries indicated that four of the countries namely, Gambia, Lesotho, Tanzania and Uganda have not succeeded in developing policies to guide in providing adequate pre-service training facilities to meet their current and future teacher demand (Sinyolo, 2007). As a result these countries have shortage of qualified teachers in their schools. Policies imposed by the World Bank and the International Monetary Fund (IMF) have undermined the very education system they are supposed to promote and support in some developing countries. The World Bank and IMF have continued to put caps on the public sector wage bill in many developing countries thereby making it difficult for these countries to employ more teachers (Sinyolo, 2007). Kenya, as a result has been unable to employ more teachers despite the increase in student enrolment due to an agreement reached with IMF in 1997 (Action Aid International, 2006). In Zambia, just like in Kenya, the education system has many schools without qualified teachers, yet it has many qualified teachers who are unemployed due to budgetary constraints and economic conditions imposed on the country by World Bank and IMF (Sinyolo, 2007).

2.3 Factors Affecting Teacher Demand

A large number of factors affect the magnitude of teacher demand and teacher shortages (Boe, 1990). The factors influencing teacher demand vary considerably between countries. The most common factors are lack of interest in teaching as a career, the aging of the teaching workforce, increase in secondary school student enrolment, and lack of teachers in key subject areas (Santiago, 2002). The lack of interest in teaching as a career particularly in key subject areas is a great factor influencing teacher shortages. Studies in Australia and other OECD countries indicate lack of interest in teaching as a career. The reasons most cited include the declining status of teaching in society, a decline in relative teaching salaries and a decline in students' perceptions of the teaching profession. Canadian Teachers' Federation (2000) in their analysis of French districts, reported that, lack of interest in teaching as a career was seen as the fourth most significant factor impacting on teacher shortages over the last five years. The decline in the attractiveness of teaching may also be associated with the decline of teachers' salaries relative to other occupations. All OECD countries, except Greece and New Zealand, for example experienced a decline in teacher salaries relative to GDP per capita in late 1990s and early 2000 (OECD, 2001). Most of these factors are relevant in Kenya where teacher salaries are relatively lower than in other professions. However, lack of interest in teaching career is not an important factor in Kenyan scenario due to high rate of unemployment.

Research in Canada, United States and Europe has suggested that the aging of the teaching workforce is expected to have a significant impact on teacher demand in those countries. The Canadian Teacher Federation (2000) indicated that teacher retirement was the most significant factor impacting on teacher shortages. In the UK, it was projected that forty five percent of the teachers would reach retirement age between 2001 and 2005 (Johnson, 2001). According to data available, over one-fifth of the teaching population in Europe will have reached retirement age between 2002 and 2012 (Eurydice, 2002). According to the OECD Report on Education Policy Analysis (2002), it is generally in the upper secondary education that the recruitment challenges implied by an aging teacher workforce are likely to be most marked (OECD, 2002). This study established that Kenya has an aging teacher workforce at the secondary school level especially due to freeze of employment in 1998 and change in teacher recruitment policy in 2001.

Studies in developed countries have revealed widespread concern for the lack of supply of teachers in certain subject areas, including, physics, chemistry, mathematics, languages and information technology (Santiago, 2002). A study carried out in Australia reported that there were low frequencies of teacher education course completions with specialization in physics, chemistry, mathematics, languages and information technology (Ballaynte, Blaine & Preston, 2001).

Teacher certification is a factor with profound influence in the supply of teachers. Teacher shortage is a function of certification status of existing and prospective teachers. The possession of standard certification is used as an operational definition of a fully qualified teacher (Boe, 1990). Teachers hired with less than full certification are commonly thought not to alleviate the shortage problem but to be a stopgap measure.

While many studies demonstrate that teachers choose a career in teaching for intrinsic reasons (Reid & Caudwell, 1997), many other studies suggest that teachers are not remunerated sufficiently for their significant role in society. A number of studies investigated the effect "opportunity cost" had on teacher's career choice (Murnane, Richard & Randhall, 1989). Thus the level of salary can influence teacher decision to follow a career in teaching or to move to another profession. Dolton and Van Der Klaauw (1999) agreed with this observation when they conducted an economic estimation, which highlighted the importance of wage and relative foregone earnings in teacher turnover decisions. There is evidence in OECD countries that teacher's attrition is higher in the early years of teaching (OECD, 2001). Dolton (1990) investigated how important relative earnings and personal non-pecuniary factors were in UK graduates' decision to become a teacher. The results of the study suggested that relative earnings in teaching and non-teaching occupations have a marked effect on graduate choice of teaching career.

2.4 Teacher Demand: National and Global Review

2.4.1 Teacher Demand in Developed Countries

Studies about the significance of education in developed countries show a clear relation between teachers with a complete teacher education and good results. For example, studies in the USA show that teachers without a complete teachers' education had lower results, were less satisfied with their work and more likely to leave the profession than teachers with a

complete teacher education (Darling-Hammond, Berry & Thorenson, 2001). In those states where teachers' salaries were increased together with an investment on the teachers' qualifications as a way to improve education's quality, the teacher achieved better students' results. On the contrary, the states that focused on a detailed curriculum and standardised tests of the students did not improve the students' results (Darling-Hammond *et al.*, 2001).

A review of demand for teachers in secondary schools in developed countries reveals a wide range of similarities. In the United Kingdom, according to the Department of Education and Skills Annual Survey 2002, the shortage of teachers has been increasing over the years. Between 1995 and 2002 the overall vacancy rate quadrupled from 0.3 percent to 1.2 percent. It peaked during this period at 1.4 percent in 2001. The highest vacancy rates existed in the subject areas of mathematics, information technology, foreign languages and music. Recruitment difficulties were reported in some geographical areas. London and East/South England experienced high demand for teachers than other areas.

In the United States, shortage of teachers has characterized the US labour market for the most part of the 20th century. According to the US National Centre of Education and Statistics (2002) report, shortages as measured by vacancy rates and more qualitative measures of recruitment difficulties were most pronounced in bilingual education, chemistry, mathematics, and computer science. The problem worsened with increasing student enrolments and teachers retirement (Maloney & Lashway, 2005).

In New Zealand according to the Ministry of Education (2002) at the secondary level, teachers in mathematics, science and technology continue to be in high demand. The highest shortages were recorded in the rural and minor-urban areas. In Canada a survey of Canadian school Boards on supply demand issues (2000) found out that teacher shortages were most prevalent in science subjects. Ontario Teachers Federation reported in April 2001 that demand for qualified teachers had increased at a faster rate than supply over the previous three years. Shortages were being experienced in mathematics, physics, technology and computer studies. Teacher retirement was seen as the main cause of recruitment difficulties.

In Australia, high shortages of teachers are experienced in the rural and remote geographical regions. The factors causing high shortages were aging workforce and competition from other

careers for mathematics, science and technology graduates. Variation in student numbers and class sizes are also common causes of recruitment difficulties. The audit of the Victorian teacher labour market found that, the overall demand for teachers is driven by demographic factors, Government budget considerations, education policies and practices, school class sizes, school retention rates and student-teacher ratios set by the Government.

2.4.2 Teacher Demand in Developing Countries

Pressure on Governments in Sub-Saharan Africa (SSA) to expand secondary education is growing. Increasing numbers of students flowing from expanded primary education and the need to improve the educational levels of the labour force to benefit from a globalizing economy make it inevitable that Governments in Sub-Saharan Africa will turn their attention to expanding and improving secondary education (Alvarez, 2003; Mulkeen, 2005; SEIA, 2007; World Bank, 2006; World Bank, 2007).

Participation rates for secondary education in Sub-Saharan Africa are lower than any region of the world, with access biased in favour of the wealthier populations (SEIA 2001). The lack of access to secondary education is increasingly seen to constrain countries' abilities to pursue effective economic growth and development strategies, which is leading Governments and the funding community to place increased emphasis on the expansion of secondary education (SEIA 2001; UNESCO 2001; World Bank 2005). Teacher recruitment and retention is one of the most critical factors to ensuring that students have access to secondary education (Moore *et al*., 2008).

In Sub-Saharan Africa as well as in developing countries in other regions, the projected demand for teachers exceeds the projected supply required for expanding secondary education (World Bank 2006; Moore, Destrofano, Terway & Balwanz, 2008). The literature generally acknowledges the lack of teachers, but fails to quantify the teacher gap. The shortage of teachers is one of the major challenges facing education in many countries and especially in Sub-Saharan Africa (Zambia Country Report, 2000; Zimbabwe Country Report, 2000). For example in Benin, Central Africa Republic, Chad, Congo, Gabon, Malawi, Mali, Mozambique and Senegal, are facing teacher shortages as compared to developed countries (Siniscalco, 2002). Among the constraints are the limited number of potential teacher candidates and the lack of space and funding in the Teacher Training Colleges (TTIs), which

together currently prevent countries from producing sufficient numbers of qualified teachers. In addition to limited capacity to produce teachers, Governments are also constrained in their ability to assign and keep teachers in remote and otherwise underserved areas, and lack the resources to support the higher wage bill implied by a dramatic expansion of the teaching force (DeStefano, 2006).

In most Sub-Saharan countries, the demand for secondary teachers will significantly exceed the projected supply and historical annual growth rates of the teaching force (Moore, 2008). Factors such as teacher attrition, HIV/AIDS, and bottlenecks in the teacher preparation system constrain most of these countries from expanding even lower secondary education (Mulkeen *et al*., 2005).

In Zambia, moderate improvements in student flow and transition to secondary education would lead to a shortfall of approximately 21,258 teachers in 2015. To meet the shortfall would require net annual growth rates of approximately 8 percent - a percentage increase of 60 percent over the existing rate of growth in teacher supply. Like Kenya, Zambia has set a target of reaching 70 percent transition into lower secondary by the end of 2007. To meet this target would require nearly 12,000 additional new teachers for lower secondary.

In the Latin America and Asian countries secondary teacher supply can continue to grow at the existing rates of expansion and meet the demand for secondary school teacher places, even if transition to secondary education increases (Di Gropello, 2006; Moore *et al*., 2008). For example Secondary GER in the Latin American countries increased from 49 percent to 88 percent from 1990–2005 and shows little sign of reducing, as the economies require more skilled workforce. As more and more students continue to enter the secondary system, these countries will require the teacher education systems to continue supplying teachers at a similar rate to what has historically held for the country. This situation is particularly relevant for countries such as Brazil, El Salvador, and Bolivia, where lower secondary education has been made compulsory (Di Gropello, 2006). Cambodia, Laos, and the Philippines serve as examples from East and South East Asia region which show that the need for additional secondary school teachers will still be present through 2015, though at a slower pace than historically was needed (Moore *et al*., 2008).

However, countries in Sub-Saharan Africa face a much different situation than both the Latin American countries and Asian regions. In most Sub-Saharan countries, the demand for secondary teachers is projected to significantly exceed the projected supply and historical annual growth rates of the teaching force (Moore *et al*., 2008). Based on the moderate scenario of improved flow and transition, Malawi and Kenya would need to nearly double the number of teachers in lower secondary education to meet the demands of an expanding system. In 2005, the Ministry of Education in Kenya announced that it would focus on increasing the transition rate into secondary education from 47 percent to 70 percent by 2008. This according to Moore *et al.* (2008) was unrealistic goal since according to their projection model assuming that there are no changes or improvements to GIR, student-teacher ratios, or student flow through primary education, projection model shows that Kenya will need more than 96,000 new teachers in the secondary school level to meet this goal.

A survey conducted by Education International in six Anglophone Sub-Saharan countries indicated that Gambia, Lesotho, Tanzania and Uganda had shortage of teachers that affected both primary and secondary levels (Sinyolo, 2007). For example, in 2006, 44% of the primary school teachers and 42% of the secondary school teachers in Lesotho were unqualified. The same study indicated that Kenya and Zambia did not have adequate numbers of teachers in their schools as evidenced by high pupil-teacher ratios yet they have so many qualified teachers in the job market. Teacher shortages were reported to have been more acute in remote rural areas. All the six countries investigated had a shortage of mathematics and science teachers. However, the shortages are less acute in Kenya, due to the country's programme to train, recruit and retain mathematics and science teachers (Sinyolo, 2007).

The average rate of teacher attrition in Sub-Saharan countries was estimated at 4% (Sinyolo, 2007). Most of the attrition was attributed to retirement, resignations, death and dismissals. AIDS related illnesses were indicated to contribute to the high rate of teacher attrition, especially in Lesotho and Zambia. Brain drain was also contributed to the high level of teacher attrition in Zambia, particularly at secondary level. The main cause of brain-drain was cited as low salaries and poor conditions of service. Teachers' salaries were reported to be generally low and below the poverty datum line2 or cost of living. Conditions of service are also poor and many of the countries did not have adequate accommodation for teachers.

Studies in Gambia pointed out that the demand for teachers depended on the class size, the teacher-pupil ratio and the teaching loads (Siniscalco, 2002). Similarly, studies on supply for secondary level teachers in Tanzania asserted that the number of teachers demanded was determined by the teaching load (Siniscalco, 2002).

In Gambia, in order to increase the teacher supply, new colleges were started, expansion of the curriculum took place and secondary school finishers were encouraged to be trained for primary schools. On the other hand, a study by Hanson and Ferns (1970) on supply of teachers in Liberia revealed that salaries were very low. This worsened the situation because teachers left teaching to join civil service and the private sector where salaries were relatively higher.

The EFA Global Monitoring Report (2002) noted that the teacher's qualifications are essential to the learning outcome of education, and it is even more important in developing countries than in developed countries. Many developing countries identify the teacher's qualifications as crucial for a quality education. As a consequence, some of these countries, namely Botswana, Tanzania and Mozambique, have raised the minimum qualifications to teach in primary school and secondary schools (Nilson, 2003). All these countries however, struggle with a very high proportion of unqualified teachers. Many teachers in the African schools have insufficient qualifications (World Bank, 2003).

As primary education level expand in most of the developing countries and increased enrolment toward attainment of universal primary education the confluence of the push-pull factors in education will continue to force countries to expand secondary options for young people. As these projections have shown, countries in Sub-Saharan Africa will need to significantly increase the annual output of their training institutions, often doubling what have been their historical rates of growth in teacher supply, or find alternative sources of potential teachers to meet these demands (Moore *et al*., 2008).

Basically, these studies indicate that developing countries are faced with the problem of adequate qualified teachers. Also, the demand for teachers depends on pupil-teacher ratio and teaching load. Similarly, terms and conditions of service influence teacher attrition and retention. Lastly, the teacher-training institutions are the main sources of the teachers

demanded in schools. There is need for the present study to focus on projecting enrolment of graduate teachers in universities as a viable strategy to ensure that public and private secondary schools are adequately staffed with qualified teachers.

2.4.3 Teacher Demand in Kenya

During the 1960s, the supply of secondary school teachers in Kenya did not meet the demand thus the Government had to rely heavily on expatriates through the Teachers for East Africa (TEA) and the American Peace Corps (Eshiwani, 1993). In the 1990s, Otiende, Wamahiu and Karagu (1992) observed that the teaching profession had the capacity to absorb more graduates given the rapid quantitative expansion of primary and secondary education after independence. At first, teaching was generally viewed as a second rate profession, at best, a stepping stone to other more remunerative and prestigious professions. However, due to saturation of the labour market for non-specialized graduates, more secondary school leavers were turning to teaching as a field of study at the university, since employment of education graduates was guaranteed (Otiende, et at, 1992). The establishment of faculties of education at University of Nairobi, Moi University and Egerton Universities in addition to Kenyatta University was reflective of the growing demand for secondary school teachers in Kenya. The 1998 freezing of teacher employment and change of teacher recruitment policy in 2001 have greatly affected the demand and supply of teachers in the country.

A number of studies on teacher labour market in Kenya have sought to establish the factors influencing teacher demand. Kizito (2004), observed that search for better paying jobs, further studies and deaths had greater influence on secondary school teachers' attrition than retirement, interdiction and poor working conditions. According to Indire and Sifuna (1994) demand for secondary teachers in Kenya depended on the class size and the number of subjects taught. Eshiwani (1993) observed that teachers, especially in secondary schools left the teaching profession to join other sectors of the economy that are more rewarding.

A study done by Mbuthia (1999) on projected need for science teachers in secondary schools in Kenya revealed that on average the shortage of Science based teacher's amounts to 49.25 per cent of the entire secondary level teaching force requirement for any given year. The study recommended that there is need not only to investigate the level of demand in other fields but also to translate the same into enrolments in respective teacher training

programmes. These studies point out that the demand for teachers is determined by pupil-teacher ratio, number of subjects taught, and existing staffing policies.

Currently, lack of reliable teacher recruitment and management for public schools in Kenya, has affected deployment of teachers and thus distorted their distribution. Consequently, there exists an unbalanced distribution of teachers (GoK, 1999; MOEST, 2005a). The present study aims at identifying and determining the effects of the factors affecting demand for secondary schools teachers in Kenya with a view to establishing a reliable projection model to be used by policy makers.

Literature suggests that teachers are often used inefficiently within schools, teaching fewer class hours at the secondary level (Mulkeen *et al*., 2005). Ministries of Education could utilize existing teachers more efficiently by having teachers teach multiple subjects and by sharing teachers across schools (Mulkeen *et al*., 2005; World Bank 2005). Studies have shown that secondary school teachers in Kenya are not efficiently utilized (Moore *et al*., 2008; World Bank 2005; Ngware *et al*., 2006). Teachers teach on average 22 hours instead of the recommended 27 hours per week (TSC, 2007). World Bank (2005) suggests that, existing teachers could be utilized more efficiently by having teachers teach multiple subjects and sharing teachers across schools. According to Moore *et al*. (2008), in Kenya it was estimated that increasing secondary school teacher work load from 18 to 25 hours per week, increasing student teacher ratio to 45:1, expanding existing schools to at least three streams and sharing teachers across schools would enable 50 per cent increase in secondary school enrolment without adding more teachers.

Moore *et al.* (2008) described the Ministry of Education target of increasing the transition rate into secondary education level from 47 percent to 70 percent by 2008 unrealistic since it would have required 96,000 new teachers to meet that goal. According to them more moderate improvements in flow and transition rates in Kenya over a longer period of time (25 percent from 2006–2015) would lead to a demand for 118,818 additional teachers in secondary education by 2015, a gap of approximately 71,234 teachers based on the historical rate of growth in teacher supply. To meet this projected additional enrollment, the annual growth rate in teacher supply would need to increase from 3 percent to approximately 8 percent per annum. The projected fifty percent (50%) improvement in flow and transition,

would require a 12 percent annual growth rate (four times the existing rate) in the supply of teachers for 10 years to ensure that over 97,000 new teachers can be hired.

By 2010, the problem of teacher shortage in Kenya had reached crisis level. According to Muriithi (2010), the Kenya National Union of Teachers wanted the government to declare the shortage of teachers a national disaster. In September, 2011 primary and secondary school teachers in Kenya went on a National strike. The strike was only called off after the government agreed to employ additional teachers.

From the existing studies it is clear that teachers in public schools are under utilized, however the effects of the factors that contribute to teacher under utilization in Kenya secondary schools is not known. It is therefore important to establish the effects of the factors that influence secondary school teacher demand so that corrective measures may be taken to reduce teacher under utilization.

2.5 Theories and Models of Teacher Demand

A teacher demand projection model consists of a set of mathematical relationships whose future levels of demand and quality can be estimated and linked to future economic and educational conditions and policies (Boe & Gilford, 1992). A complete teacher supply-demand model consist of three main components or sub-models: (i) a sub-model for projecting demand for teachers; (ii) a sub model for projecting the supply of continuing or retained teachers (a model for teacher attrition); and (iii) a sub-model of supply of potential entrant into teaching. This study concentrates on the first sub-model which represents a model for projecting demand for teachers.

2.5.1 Teacher Demand Projection Models

According to Boe & Gilford (1992), the simple, mechanical standard model projects the future demand for teachers (either in the aggregate or in a particular category) as:

$$PTD_t = PE_t \times PPTR_t \quad \text{.....Equation 1}$$

Where: $PTD_t \rightarrow$ Projected number of Teacher Demand in year t

$PE_t \rightarrow$ Projected Enrolment in year t

$PPTR_t \rightarrow$ Projected Pupil-Teacher Ratio in year t

The projected number of teachers demanded refers to all teachers or to teachers in a particular level and/or in a particular subject area; the projected teacher-pupil ratio refer to the same level and/or subject category and the projected enrolment is either aggregate enrolment in the specified level or course enrolment in the specified subject area. The mechanical model implicitly reflects the assumption that all major influences on demand will either remain constant or continue to change at the same rates at which they have been changing in the past. If anything substantially different were to happen, for instance if local fiscal conditions were to change or if the relative salaries of the teachers were to rise or fall sharply, the projections obtained from such models would probably be incorrect.

Although some standard models break down teacher demand by subject area, they do so only by assuming that the mix of course enrolment by subject area, will remain the same in the future as it is today. The models do not make allowances for different trends in programmes taking different fields or for specific developments as changes in curricula and graduation requirements. The model also assumes that market for each type of teacher is and has been in a condition of excess supply. Although this assumption is realistic for teacher in the aggregate, it may not be valid for certain specific fields. The mechanical demand models can be made more useful by making them behavioural. This can be done by basing demand projections on multivariate econometric models relating number of teachers to the fiscal, economic and demographic factors that determine how many the teacher market is willing and able to employ.

The National Centre of Education and Statistics (NCES) of USA used regression equation fitted to national time series data to predict future numbers of public elementary and secondary teachers (Gerald, Debra & William, 1990). The NCES regression equation for elementary and secondary teachers both relate to the number of teachers demanded for enrolment, per capita income and state education aid per pupil. The equation used to project the number of secondary teachers in USA as presented in Gerald and Hussar (1990) is:

$$SCTCH = b_0 + b_1 PCI_{-2} + b_2 SGRANT_{-3} + b_3 SCENR \quad \text{……..Equation 2}$$

Where:

$SCTCH \rightarrow$ number of secondary teachers

$PCI_{-2} \rightarrow$ disposable income per capita (adjusted for inflation) lagged 2 years

$SGRANT_{-3} \rightarrow$ local education revenue receipts from state sources per capita (adjusted for inflation) lagged 3 years

$SCENR \rightarrow$ secondary school enrolment.

From a theoretical perspective, the regression equation presented by NCES requirement only part of the model of the demand for teachers rather than a complete theory – based specification. Although the model allow for the effect of per capita on demand, they leave out the pupil-population ratio and the price (relative salary) of teachers, even though the relevance of both is well established in the literature.

According to the prevalence model, the total demand for teachers is defined as the number of students divided by a predetermined student/teacher ratio. In practice this ratio is set by policy makers and is constrained by a local education agency's (LEA) ability to fund teaching positions. Others, such as advocacy groups and researchers, may set any ratios they deem appropriate. Therefore, under the prevalence model, estimates of teacher demand depend upon the assumptions made by the source reporting it and may vary widely (Coelen & Wilson, 1987). In contrast, the Market-Based Model defines the total demand for teachers as the number of full-time equivalent (FTE) teaching positions approved and funded (Boe, 1990). Estimates of teacher demand under the market model require empirical data and should not vary greatly from one source to another if definitions of teaching positions are comparable and data of reasonable quality are available (Lauritzen, 1989). The disadvantage of these models is that they are not useful estimates of teacher demand since they are not stratified by teaching field, instructional level, geographic location, and teacher qualifications required (Boe, 1990). Ideally, total demand would be the aggregate of the specific demand for teachers in all these strata.

2.6 Conceptual Framework

The conceptual framework of this study was based on Teacher Demand, Supply, and Shortages (TDSS) Models (Boe, 1990). The framework depicts models that may be used to present the complex relationship between variables that influence teacher demand and the structural elements shaping them. The models also suggest a method in which future demand for teachers can be based.

The conceptual framework depicted the structure of the projected demand for teachers, which identifies the factors that shape the demand for teachers. Demand for teachers is complex issue because it depends on many variables some of which can change unexpectedly. Demand for teachers deal with the aspects that determine the number of teachers needed for an educational system to respond to the educational needs of the entire secondary school-age population.

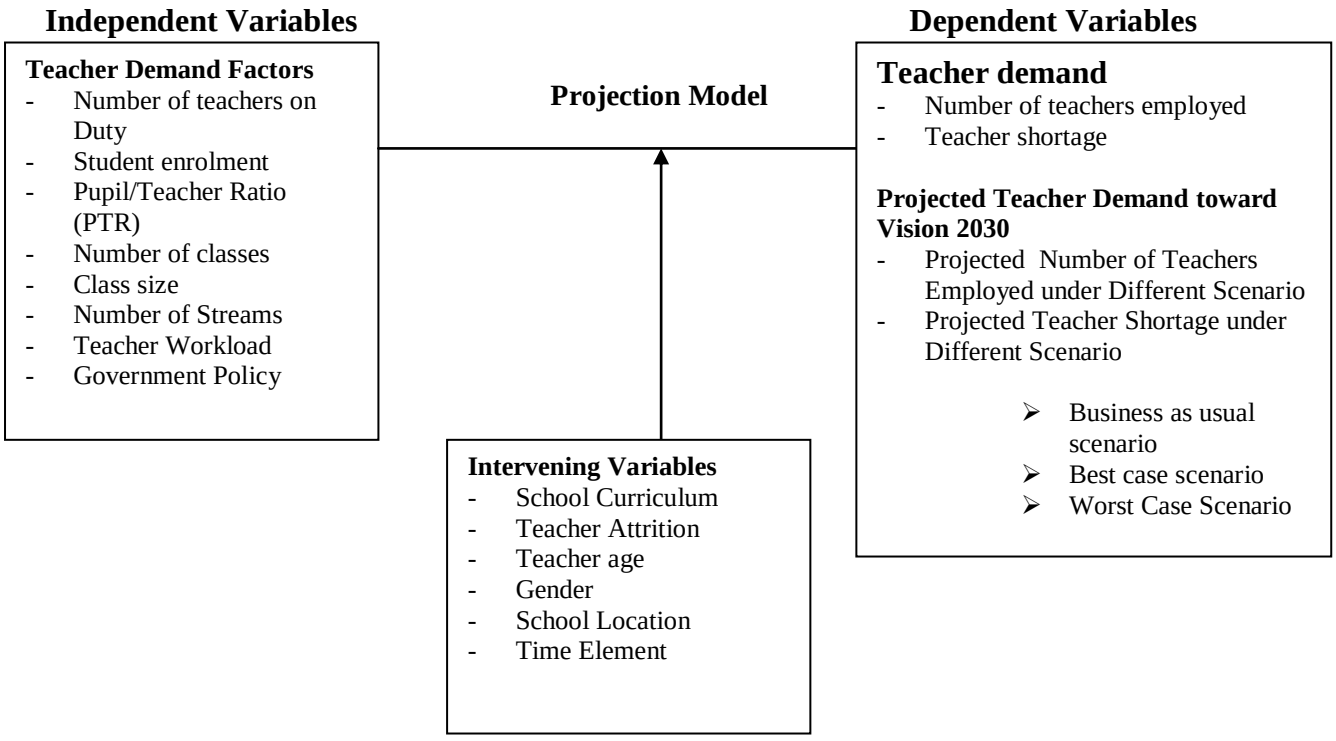

Figure 2: Projecting future teacher demand
Source: Own conceptual model

The effects of the factors influencing teacher demand is seen in terms of their separate influence as depicted in the teacher demand model. The conceptual framework further suggests that with the understanding of the magnitude of the effect of each of the factors influencing demand, educational planners can use the model in projecting future secondary school teacher demand in Kenya.

2.6.1 Teacher Demand Model Specification

The following Poisson regression model was used in this study to project the demand for secondary school teacher:

$$Ln(y) = a + bx_1 + cx_2 + dx_3 + ... + \varepsilon \quad \text{.....Equation 3}$$

where: y = teacher demand

a = Constant

bx_1= Number of teachers on duty

cx_2 = Student enrolment

dx_3 = PTR

eX_4 = Number of Classes

fx_5 = Average class size

gx_6 = Number of streams

hx_7 = Number of teachers employed

ix_8 = Average teacher workload

jX_9 = Government policy

ε = error term

The dependent and independent variables in this study were subjected to Poison Regression to establish the extent to which the set of independent variables explained a proportion of variance in the dependent variable. The resulting Poisson Regression model was used to project future teacher demand.

Poisson regression was appropriate in this study since the dependent variable was a count variable. The events were independent in the sense that there is independence among schools in terms of teacher demand, meaning that computation of the teacher demand in one school is not influenced by findings (teacher demand) from other schools. The distribution of independent (teacher demand factors) and dependent variable (teacher demand) data was not normal an indication that use of Poisson Regression was appropriate.

2.6.2 Definition of Variables

Independent Variables

The independent variables in this study included the following teacher demand factors:

Number of Teachers on Duty. The number of teachers on duty refers to the total number of teachers employed by the Government and teaching in a public secondary school. The number of teachers on duty were measured by extracting the information of the sampled schools on staffing establishment from the schools returns to the TSC.

Student enrolment: Student enrolment refers to the total number of student registered and schooling in a school during the study period. The data on student enrolment was obtained from the schools' returns at the TSC headquarters.

Pupil/Teacher Ratio (PTR): The PTR refers to the proportion of teachers as compared to the number of students in a secondary school. PTR was measured by dividing the total number of students in a school by the number of Government employed teachers.

Number of classes: Number of classes refers to the total of separate student groups taught together by a teacher in the school. Information on number of classes was obtained from the schools returns at the TSC headquarters.

Class size: Class size referred to the size of student population in a class. The class size was measured by dividing the total student population by the number of classes.

Number of Streams: Number of streams refers to the number of separate groups of students in each grade/form. The number of streams was obtained from the data in the schools returns at the TSC headquarters.

Teacher Workload: Teacher workload refers the number of 40 minutes lessons a teacher covers in a secondary in one week. Teacher workload was measured by calculating the average number of lessons covered by teachers in the sampled schools.

Government Policy: Government policy referred to Government decisions affecting, recruitment, deployment, utilization and transfer of teachers in public secondary schools.

Government policy was measured by estimating the magnitude of the influence of Government decisions on teacher demand during the study period.

Dependent Variable:

The dependent variable in this study was secondary school teacher demand. Teacher demand was measured by calculating the total teacher shortage in each of the sampled schools.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the procedures and the methods the researcher employed to carry out the study. The section comprises the research design, study population, sampling procedures, data collecting instruments, validity of the instruments, reliability, methods of data collection and analytical techniques. The choice of specific research techniques have also been justified and applied in the composition of teacher demand parameters and projection models.

3.2 Research Design

The research design adopted in this study was cross-sectional research design using time series data. This is a type of survey involving data collection at single points in time. Data on selected factors and demand for secondary school teachers were collected for the period 1990 to 2007. Because the study involved collection of independent data sets for every year, the specific type of cross-sectional design was trend study. This was in line with the attribute of cross-sectional research design that involves collection of qualitative and/or quantitative body of data in connection with two or more variables in order to establish any relational patterns between them (Bryman, 2004). As a type of non-experimental research, the study involved, based on the research objectives, description to provide a picture of the status or characteristics of the secondary school teacher demand phenomena; prediction of future teacher demand and explanation of the trends in teacher demand through causal modelling.

3.3 Study Population

The population of this study included all the 4236 public secondary schools in Kenya in 2007, all graduate and diploma teachers who have been teaching in secondary schools in Kenya between 1990 and 2007 and sixteen Teacher Service Commission (TSC) provincial staffing officers. The study also targeted the TSC for records of all secondary schools in Kenya between 1990 and 2007.

3.4 Sampling Procedures Sample Size

Simple random sampling was used to select 351 secondary schools from the total of 4236 public secondary schools in Kenya. The sample size of the schools was based on sample selection table by Kathuri and Palls (1992). Purposive sampling was used to select eight

provincial staffing officers at the TSC Headquarters. The staffing officers were purposively selected because they have pertinent information relating to teacher recruitment policy as well as trends and issues related to teacher demand and supply in their respective provinces. All the eight staffing officers are based at the TSC headquarters in Nairobi making it easy and cost effective to access and interview them. According to Trochim (2009), purposive sampling seeks to select one or more specific predetermined groups meeting specific study requirements and may involve modal instance, expert or quarter sampling. In this study, the expert sampling of provincial staffing officers with known and demonstrated experience and expertise were selected for detailed individual interviews and convened as a panel of experts. Data of all graduate and diploma teachers employed by the TSC in public secondary schools between 1990 and 2007 were collected from the TSC records.

3.5 Instrumentation

Data needed for this study was collected by use of two data analysis profoma and one Interview Schedule. The *Trained secondary school teacher demand profoma* (Appendix A) was used to collect data from TSC records on trends in graduate and diploma teacher requirement and on post in secondary schools by subject categories between 1990 and 2007. The *secondary school demographic data profoma* (Appendix B) was used to collect data from the sampled public secondary schools on student enrolment, PTR, average class size, number of streams, number of teachers on post, number of teachers employed and average teacher workload in 2007. *Provincial Staffing Officer Interview Schedule* (Appendix C) was a semi-structured interview schedule that was used to collect data on factors influencing secondary school teacher demand in different provinces in Kenya.

3.6 Validity of Data Collection Instruments

The study established the validity of the research instruments (profoma and interview schedule) before proceeding to the field to collect data. The validity of the data analysis profoma and interview schedule was ascertained based on construct, content and face validity. The study ensured that all the items in the instruments were representative of the entire content domain being measured as represented by the variables and objectives of the study. This was ascertained by ensuring that all the objectives and variables of the study were addressed by the items in the data analysis proforma and the interview schedule as defined in the study. The study also sought the help of independent educational researchers and

instrumentation experts to asses the validity of the data collecting tools. Appropriate adjustments and corrections were done to the instruments to address any validity weaknesses.

3.7 Reliability of the Data

The reliability of the data collected was ascertained through triangulation of the data sets collected from TSC and those from in the MoE. The study randomly selected 35(10%) of the sampled schools for data collection at the school level for triangulation. The data sets from the school level and those from the TSC were correlated to test their consistency. The data sets yielded Pearson's correlation coefficient of 0.00 at 0.05 significance level, an indication that the data collected from TSC and MoE were reliable.

3.8 Data Collection Procedures

After obtaining approval from the graduate school of Egerton university, the researcher sought for permission from the Ministry of Education Science and Technology to conduct the research. After obtaining the permit from the MOEST (Appendix D) the researcher established communication with the TSC and MOE headquarters' to collect the data needed for this study. The researcher collected data from the TSC records and conducted interviews with provincial staffing officers at the TSC headquarters.

3.9 Data Analysis

The collected data were organized and prepared for analysis by coding and entry into the Statistical Package for Social Sciences (SPSS) version 15.0 software and STATA. The data were then edited before being classified and summarized according to the variables and objectives of the study. Data summary and classification were done using descriptive statistics and presented using tables and graphs. In order to answer specific research questions, statistical procedures were used, including trend analysis and Poisson Regression. Diagnostic tests to check the suitability of the Poisson Regression were done using Dagostino Pearson test and Shapilo-wilk W test for normal data. The secondary school teacher demand model was developed based on Poisson Regression. The projections were based on simulations of the most significant teacher demand factors under three different scenarios: Business as usual; Best Case scenario; and Worst case scenario.

Table 1: Summary of Data Analysis Procedure

Research question	Independent variable	Dependent variable	Analytical tool
What were the trends of secondary school teacher demand in Kenya between 1990 and 2007?	Time in years	Demand for trained secondary school teachers	Trend analysis Descriptive statistics
What were the effects of the factors affecting demand for trained secondary school teachers in Kenya?	Teachers on duty Student enrolment PTR Class size Number of streams Number of teachers employed Teacher workload Government policy	Demand for trained secondary school teachers (Teacher shortage)	Poisson regression Dagostino Pearson test Shapilo-wilk W test for normal data Descriptive statistics
What is the projected future demand for trained secondary school teachers in Kenya?	Teachers of duty Student enrolment PTR Average class size Number of streams Number of teachers employed Average teacher workload Policy	Projected demand of trained secondary school teachers (Teacher shortage)	Poisson regression Descriptive statistics

CHAPTER FOUR

DATA ANALYSIS AND FINDINGS

4.1 Introduction

This chapter presents the results of this study whose main aim was to establish the trends in secondary school teacher demand factors and also offer explanations to the effects of the factors on demand as well as present, through a model, the future secondary school teacher demand projections. The chapter is organized into sections which cover: description of the study subjects; the trends of secondary school teacher demand factors; effects of secondary school teacher demand factors; and projected secondary schools teacher demand.

4.1.1 Description of Subjects

In order to form the basis for the chapter, this section presents a descriptive account of the study units including the public secondary schools; key informants who included the provincial staffing officers; and the secondary school teachers.

4.1.1.1 Public Secondary Schools in Kenya

There are two categories of secondary schools in Kenya, public and private. The public secondary schools are funded by the Government or communities and are managed through a board of governors and parent-teacher associations. The private schools, on the other hand, are established and managed by private individuals or organizations, including missionaries. In 2007 there was a total of 4236 public secondary school which comprised the study units.

The objectives of the secondary school education are to prepare students to make a positive contribution to the development of society, and to acquire attitudes of national patriotism, self-respect, self-reliance, cooperation, adaptability, and a sense of purpose and self-discipline. The secondary school curriculum covers six major areas: communication (English, Kiswahili and foreign languages), mathematics, science (physical and biological), humanities (geography, history, Government, religious education, social education, and ethics), applied education (agriculture, industrial education, wood technology, metal technology, power mechanics, electrical technology, business education, accounts, commerce, typing and office practice, home science, clothing and textiles, food and nutrition, arts, and music), and physical education.

4.1.1.2 Provincial Staffing Officers

There are sixteen TSC provincial staffing officers in Kenya, eight are stationed at the TSC headquarters Nairobi, while the other eight are stationed in the various provincial headquarters. The provincial staffing officers' responsibility is to manage teachers staffing in the secondary and post secondary public institutions in the country. The eight TSC staffing officers at the TSC headquarters' were interviewed.

4.1.1.3 Secondary School Teachers

Secondary school teachers in this study consisted of professional teachers holding diploma and degree certificates from diploma teacher training colleges and education faculties of universities. The teachers are employed and supervised by TSC. The study targeted all secondary school teachers employed by the TSC and who worked in public secondary school between 1990 and 2007. There were a total of 28,056 and 44,305 secondary school teachers in 1990 and 2007 respectively.

4.2 Trends of Secondary School Teacher Demand Factors

The study considered a number of factors known to influence demand for teachers. The main factors considered by the study to determine secondary school teacher demand in this study include, number of schools, number of teachers on duty, student enrolment, pupil teacher ratio, average class size, number of classes, class size, number of streams, teacher workload, number of teachers employed each year, teacher attrition and Government policy. This section describes the historical trends of the factors and how they have influenced secondary school teacher demand in Kenya between 1990 and 2007.

4.2.1 Trends in Number of Schools

The number of public secondary schools in Kenya increased markedly over the study period and had been a major contributor to the associated increase in teacher demand. For instance, there were 2557 secondary schools in 1990 but these had increased to 4236 in 2007 accounting for an increase of 65.7% over that period. Over the same period, there was a 57.9% percent increase in the number of teacher from 28,056 in 1990 to 44,305 in 2007. Figure 3 presents the number of secondary schools while Figure 7 presents the trends in number of teachers over the period 1990- 2007.

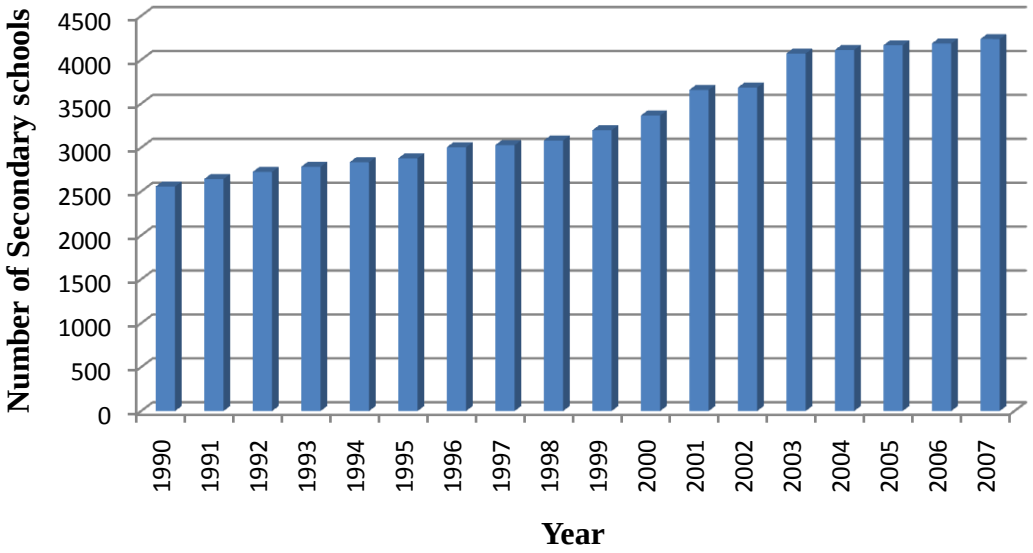

Figure 3: Number of Secondary Schools in Kenya 1990 – 2007

Establishment of harambee[1] secondary schools in Kenya by the communities after the independence resulted in a marked increase in teacher demand. Since by that time there were no enough trained techers locally, there was an influx of secondary school teachers from Uganda. The Government during the 1887/1988 financial year decided that all harambee secondary schools be converted to Governemnt secondary schools and that these school be provided with full complement of TSC teachers. This further increased secondary school teacher demand since the TSC had to employ all the teachers in these schools who had previously been employed by the communities. By that time, there were not enough teachers in some subjects notably mathematics, sciences and languages and the available teachers had to be shared among the schools (Kang'ali, 1994). Consequently, many schools had to hire untrained teachers (UT) to teach science and languages subjects. From 1990, the Government stopped employing untrained teachers. However the public secondary schools which did not get adequate teachers from the Government continued to employ such teachers under their respective Board of Governors (BOGs). A comparison of the trend in the number of schools over the study period (Figure 3) and the trend in the number of teachers on post (Figure 7) shows clearly that the number of schools have been an important determinant of teacher demand. The Pearsons Correlation coefficient between the number of schools and the number of teachers on duty was 0.003 at 0.01 significance level an indication that there was

[1] Harambee is a Swahili word which means pooling resources together for a common course. It has been used in Kenya since independence to imply raising funds and other resources for development processes including construction of schools.

significant corrrelation between the number of schools and number of teachers on duty, though a weak one.

4.2.2 Trends in School Size and Classs Size

Evidence from the study indicated that due to lack of clear policy on starting of new schools, there are many schools within the same locality without the optimum school and class sizes. The average class size in public secondary schools in Kenya was 37 in 2007 according to data collected in this study. This is below the optimum class size of 45 according to Ministry of Education benchmarks. There are regional and school disparity in class sizes with many schools having an average class size of less than 30 students per class. Thus teachers in many public secondary school in Kenya are not efficiently utilized. With the establishment of Constituency Development Fund (CDF), many communities at the constituency level are using the CDF funds to start new secondary schools. The local communities after establishing such schools then request the Ministry of Education through TSC to equip them with teachers. This further agreviates the problem of teacher shortage. While it is appreciated that increasing the number of secondary schools would increase access to education at this level, there is need for the Ministry of Education to come up with a clear policy on establishment of new schools and the minimum school size for the school to benefit from TSC teachers. Increasing the class size to optimum of 45 students means the resources at the school level will be more efficiently utilized.

4.2.3 Secondary School Enrolment

4.2.3.1 Size of student population

Demand for secondary school teachers in Kenya is determined to a large extent by the size of student population. The student population is determined by the size of the school age population, among other factors. Studies have shown that the age structure of the population may have far reaching effects on the requirements for teaching staff. For example, the North American baby boom, which lasted from mid-1940s to the early-1960s, had massive effects on students' enrolments (OECD, 2002). There was a wave of new students in the elementary level in the 1950s, and then into high school and eventually into the universities. The demand for teachers increased sharply and school systems were faced with teacher shortages. When the baby boom was replaced with baby bust in the 1960s and the ensuing decades, teacher shortage was replaced with teacher oversupply (OECD, 2002).

Student population in secondary schools in Kenya had increased at a high rate during the study period as indicated in Figure 4. The number of secondary school students increased from 618,500 in 1990 to 1,180,300 in 2007, an increase of 90.8% over 17 years.

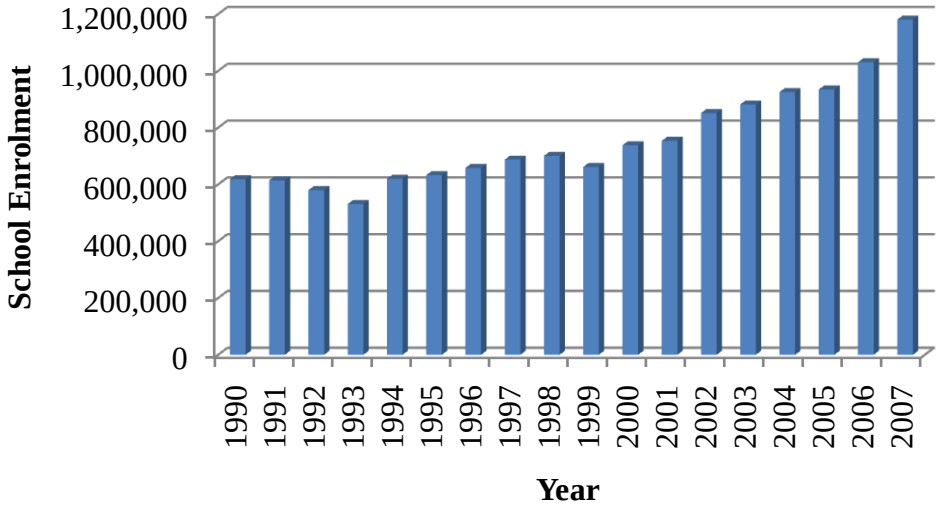

Figure 4: Secondary School Enrolment between 1990 and 2007

Comparing the trends in the number of secondary school enrolment (Figure 4) and the trend in the number of secondary school teachers (Figure 7), it is clear that student enrolment is one of the main contributing factors to teacher demand at the secondary school level. Pearson Correlation Coefficient between school enrolment and number of teachers on duty was weak (0.009) but significant (α=0.01), an indication that the there was an association that cannot be ignored.

4.2.3.2 Disparity in secondary school student enrolment between public and private schools

Comparing the proportion of student enrolment in private secondary schools to the available public schools indicated that the participation of the private sector in provision of secondary education in Kenya is still low. In 2007, private secondary schools comprised 13.7% of secondary schools in Kenya. Figure 5 presents student enrolment in puplic and private secondary schools in Kenya between 1999 and 2007.

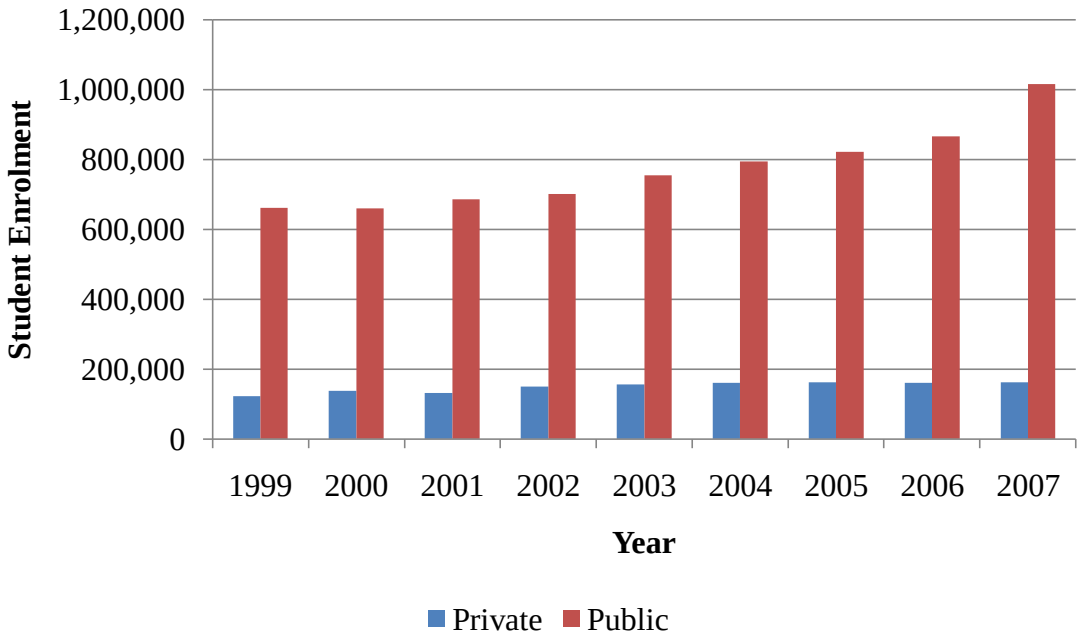

Figure 5: Enrolment in Public and Private Secondary Schools in Kenya from 1999 to 2007.

The situation was slightly different from that of 1999 where private schools comprised 19.8% of all the total enrolment in secondary schools. While the private school had expereinced 133.4% increase from 1999 to 2007, public secondary schools increased by 150.7%. With the introduction of free secondary education, the proportion of public schools is likely to increase as more students are likely to join the existing public secondary schools to benefit from free tution. The introduction of the Constituency Development Fund (CDF) was also contributing in attracting more students to public secondary schools where they are likely to benefit from the CDF bursary. As noted earlier in this study, the average class size in secondary school in Kenya was below the optimum, thus it was possible to increase student population without increasing demand for teachers and other resources.

4.2.3.3 Regional Disparity in Student Enrolment

The study revealed that there are major regional disparities in student enrolment across the country with relatively large population of students in Central, Nyanza, Rift Valley and Western Provinces. In contrast, there are low student enrolments in North Eastern, Eastern, Coast and Nairobi provinces. However, it was observed that parents from Nairobi prefer sending their children to schools outside Nairobi since there are few public boarding secondary schools in Nairobi and there also exited a large number of private schools in Nairobi that enrol students at the secondary school level but these were not be reflected in

national statistics as private schools do not make returns to TSC/MOE. Figure 6 presents secondary school student enrolment in Kenya in 2007 by province.

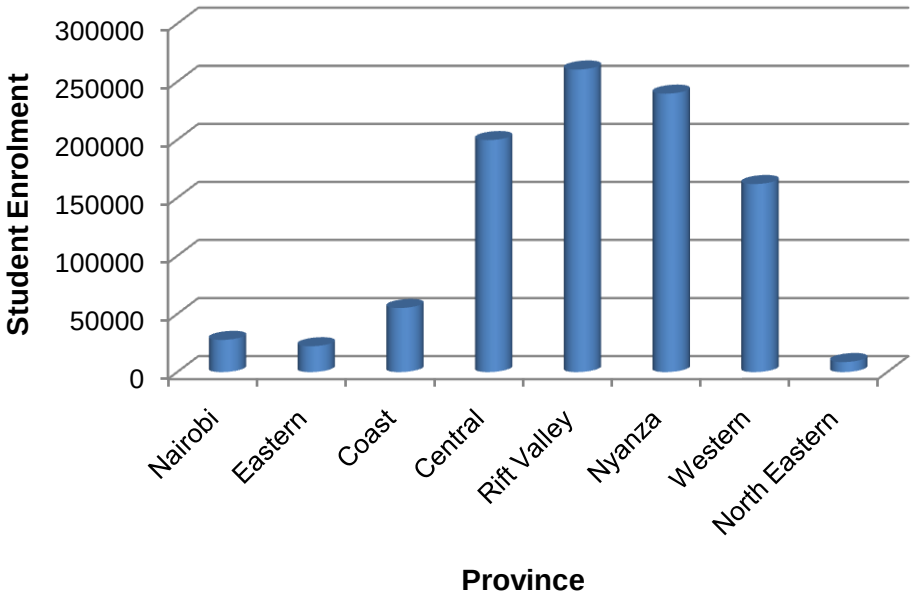

Figure 6: Secondary School Student Enrolment in Kenya in 2007 by Province

The regional disparity in the number of students is occasioned by the availability of school places as indicated by the number of secondary schools. Thus student enrolment influenced the number of teachers required. As seen in Table 2, there is similarity in regional disparity in student enrolment and number of secondary school teachers as well as teacher shortage in the corresponding regions.

Table 2: Regional Disparity in Number of School, Student Enrolment, Number of Teacher and Teacher Shortage in 2007

Province	Number of Secondary Schools	Student Enrolment	Number of Teachers Required	Number of Teachers on Duty	Teacher shortage
Nairobi	54	27739	1609	1579	30
Eastern	678	22261	5248	1769	3479
Coast	159	55198	3035	2620	405
Central	786	199798	12642	10365	2068
Rift Valley	1079	260565	14832	10615	4210
Nyanza	978	239784	13532	9008	4524
Western	574	161949	9112	7291	1821
North Eastern	43	8641	619	453	166
Total	**4351**	**955935**	**60629**	**43700**	**16703**

Source: TSC Records, 2008

The provinces with high level of teacher shortage included Nyanza, Western, Rift Valley and Eastern while Nairobi, Coast and North Eastern provinces had low level of teacher shortage. The provinces with high level of teacher shortage were mainly those with large number of schools, an indication that teachers in Kenya were not equitably distributed.

According to the TSC records in 2009, secondary school in Kenya had a teacher shortage of 23,291 (TSC, 2009). Nyanza province had the highest shortage of 6,243. Rift Valley had a shortfall of 4,909, followed by Eastern Province, with a teacher shortage of 4,255. Western Province a shortage of 3,255 teachers while Central had a teacher shortage 2,469 teacher shortfall. The Coast has a shortage of 1,063 and North Eastern had a teacher shortage of 331.

4.2.3.4 Gross Enrolment Ratio

Secondary School Gross Enrolment Rate (GER) has improved over the years from 29.0 in 2003 to 36.8 in 2007 as shown in Table 3. This is expected to further rise with the introduction of Free Day Secondary School Education (FSE) in 2008.

Table 3: School Schools' Gross Enrolment Rate 2003 to 2007

Year	Gross Enrolment Rate
2003	29
2004	29.2
2005	29.3
2006	32.2
2007	36.8

Source: MoE, 2009

The study revealed that, there are regional and gender disparities in GER as shown in Table 4. The national GER was indicated as 36% with low enrolment rate for girls as compared to that of boys. The data also indicated low GER in North Eastern and Nairobi against relatively high GER, in Central province. There were also gender disparity in GER with North Eastern, Nyanza and Coast provinces experiencing relatively low GER for girls. In contrast in Central, Eastern and Western provinces the GER for girls were relatively higher than that for boys.

The study found that while the average increase in enrolment and increase in GER are comparable at 107.1% and 106.3% respectively, the average increase in number of teachers was lower at 58%. This explains the persistent teacher shortage since teacher recruitment does not change at the same rate with increase in student enrolment. The problem of teacher

shortage is likely to be even more critical in the future with the expected increase in student enrolment and the introduction of Free Secondary Education (FSE).

Table 4: Secondary School Gross Enrolment 2007

Province/GER	Boys	Girls	Total
Coast	20	26	23
Central	44	46	45
Eastern	35	33	34
Nairobi	14	16	15
Rift Valley	30	24	27
Western	29	32	31
Nyanza	36	28	33
North Eastern	18	14	9
National	40	32	36

Source: MoE, 2009

Table 5: Comparison of Enrolment, GER, Number of Teachers and PTR in 2007

	Enrolment	Rate of Change	Number of Teachers	PTR
1990	618500		28056	19
1991	614200		30621	20
1992	579900		36560	17
1993	531000		32540	17
1994	619900		38307	18
1995	632500		41484	19
1996	658300		41280	20
1997	687300		44378	17
1998	700500		43694	17
1999	661700		40781	16
2000	738100		40090	19
2001	753500		41943	19
2002	851200		42901	19
2003	881400		42034	19
2004	925200		42584	19
2005	934200		42435	19
2006	1030100		42403	19
2007	1180300		44305	19

Source: TSC Records, 2008

The situation is also explained by the fact that since 2001 TSC has not been recruiting new teachers but only replacing teachers leaving the profession due to teacher attrition. Although the Government employed 4,200 secondary school teachers during the 2010/2011 financial year, the number was far below the teacher shortage. Furthermore the formula used in hiring 20 secondary school teachers in each of the 210 constituencies was unplanned for and not

equitable since different constituencies had different levels of teacher shortage. There is need, therefore, for a policy review to consider recruiting more teachers over the next few years to meet the expected increase in demand.

4.2.4 Secondary School Teachers on Duty in Kenya from 1990 to 2007

The study targeted all the secondary school teachers on posting from 1990 to 2007. The number of teachers in public secondary schools in the country increased from 28056 in 1990 to 44305 in 2007 an increase of 58% over the period. Figure 7 shows the trends in total number of teachers on posting between 1990 and 2007. The secondary school teachers include both diploma in education teachers and bachelor of education holders. Both B.Ed teacher and Diploma teachers have been undergoing further education programmes offered in various public and private universities including distance and school based programmes. These further education programmes are likely to affect demand and supply of secondary school teachers as well as having financial implications on the part of the Government in terms of increased teacher salaries.

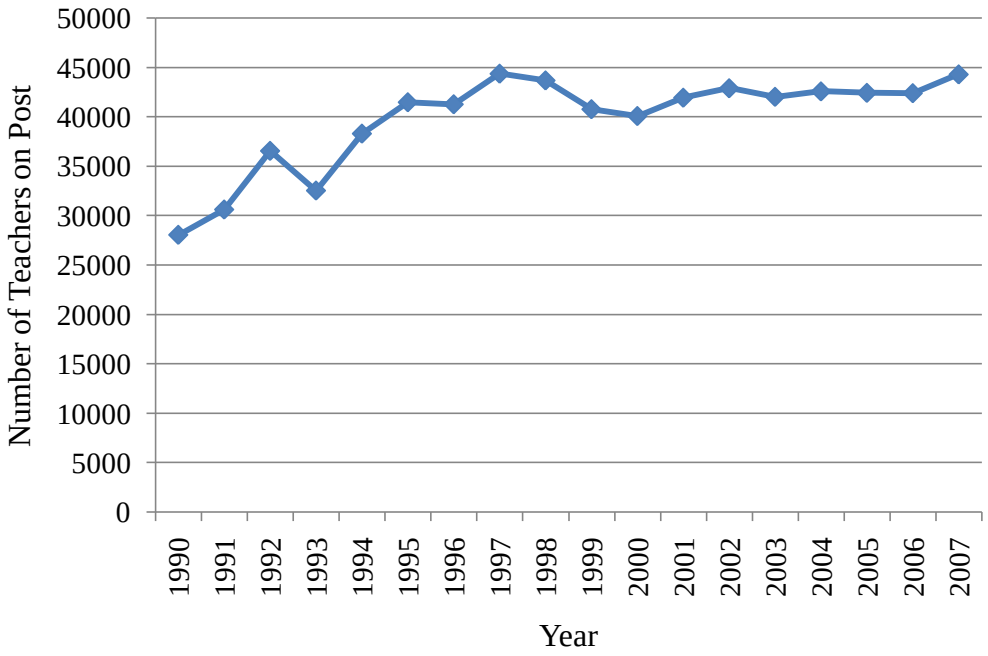

Figure 7: Number of Trained Teachers on Post in Public Secondary Schools in Kenya from 1990 to 2007

The trends of the number of trained secondary school teachers in secondary school teachers in Kenya have not been steady. In 1991 for instance the Teachers Service Commission (TSC)

employed a large number of teachers to be posted to the former harambee schools that had been converted to public schools. During the same time the diploma colleges for arts subject were phased out and converted to campuses and constituent colleges of the existing public universities. However, most of the campuses (Laikipia and Kisii) and constituent colleges (Maseno) were admitting large number of students to undertake the same art subjects but at degree level. By 1993, the 1990/1991 double intake graduates from the public universities started entering the labour market for secondary school teachers and by 1995 the demand supply balance for secondary school teachers was already experiencing some tilt. For example the secondary school teachers trained to teach History, Geography and CRE had to wait for a long time after graduating before being employed by the TSC.

The graduates from the university with art based subjects (humanities) were considered unpopular and as a result students admitted to the B.Ed programmes were unwilling to take those subjects. The 1998 freeze of employment of civil servants including teachers led to stagnation on the employment of teachers to public secondary schools. In 2001 the Government reconsidered the decision on employment of teachers and a new policy on teacher recruitment was established which focused on the replacement of those teachers leaving the profession due to natural attrition. Since 2001 there has been a slow but steady increase in the number of teachers.

The number of secondary school teachers on post varies by subject. The core subjects including Mathematics, Kiswahili and English had the majority of the teachers followed by science subjects, while optional subjects have fewer numbers of teachers. However, it was clear that the distribution of number of teaching optional subjects was not equitable. There seem to be no clear policy on how many optional subjects a school should offer and the schools were free to decide the number of optional subjects to be offered and this had resulted in under utilization of teachers of optional subjects. While it could be argued that the question of the number of optional subjects should be determined by the demand factors, experience has shown that this could lead to inefficiency in many schools as optional subject teachers are under utilized.

The distribution of secondary school teachers on post by province shows that the secondary school teachers are not equitably distributed among all the provinces in the country. While it

could be argued that teachers are distributed in relation to the number of schools or proportion of students, this is not the case in Nairobi and North Eastern provinces as seen in Table 6.

Table 6: Number of Secondary Schools, Students and Teachers on Post by Province 2004

PROVINCE	NUMBER OF SECONDARY SCHOOLS	%	NUMBER OF STUDENTS	%	TEACHER ON POST	%
CENTRAL	638	20.7	169865	22.7	9579	24.3
COAST	115	3.7	34938	4.7	1761	4.5
EASTERN	567	18.4	138139	18.4	7344	18.6
NAIROBI	15	0.5	6026	0.8	424	1.1
NORTH-EASTERN	22	0.7	5303	0.7	319	0.8
NYANZA	648	21.0	136270	18.2	6989	17.7
RIFT VALLEY	686	22.2	156514	20.9	7967	20.2
WESTERN	396	12.8	102308	13.7	5070	12.9
NATIONAL	**3087**		**749363**		**39453**	

Source: TSC Records, 2008

4.2.5 Secondary School Teachers Composition by Qualification

Majority of teachers in secondary schools in Kenya in 2007 were degree holders with either B.Ed (Arts), B.Ed (Science) and Post Graduate Diploma in Education (PGDE) specialities constituting 73%, diploma teachers comprised 24% while 4% of the secondary school teachers were untrained since they have not taken education as their field of profession. Thus the number of untrained teachers employed in secondary schools had reduced tremendously from 37% in 1990 to 4% in 2007 (Kenya, Statistical Abstract 1990 – 2008). The study also established that most public secondary schools have hired on average two BOG teachers to fill the gap of teacher shortage in each school.

4.2.6 Existing Secondary School Teacher Workforce by Subject Category

Newly employed teachers by the TSC in public schools are required to remain in the same school for a minimum of five years. The existing teacher workforce from the previous year who had been in the same school for a minimum of five years, had the option of remaining in the same position from one year to the next.

Table 7: Existing Secondary School Teachers by Subject 2007

Subject	2007
Accounting	348
Agriculture	2722
Aviation Technology	15
Biology	3611
Building Construction	56
Business Education	1388
Chemistry	2691
Christian Religious Education	1639
Commerce	372
Computer Studies	80
Drawing and Design	51
Economics	727
Electricity	47
English	6628
Fine Art and Design	71
French	148
Geography	2848
Germany	19
History and Government	3076
Home Science	796
Islamic R.E.	59
Kiswahili	5044
Mathematics	6445
Metal works	18
Music	242
Physical Education	70
Physics	2282
Power Mechanics	46
Social Education and Ethics	187
Typewriting and Office Practice	32
Wood work	78
Arabic	29
Biological Sciences	119
Physical Sciences	9
Hindu R.E.	13
Industrial Education	19
Library Science	19
TOTAL	**44,305**

Source: TSC Records, 2008

However some teachers may choose to transfer from one school to another or from one region to another. Some teachers may be promoted to senior position or transfer their services to other areas within the Ministry of Education. A large number of teachers employed by

private schools migrate to public schools each year whenever an opportunity exists due to better terms of employment. Thus the flow of practising teachers within the education system may constitute a source of teachers hired into, or reassigned to, open teaching position (OECD, 2002). Table 7 shows the existing secondary school teacher workforce by subject in 2007.

The subjects with majority of teachers include Mathematics (6445), Kiswahili (5044), and English (6628). This is because these are compulsory subjects according to the secondary school curriculum and they are scheduled to be taught for more hours in a week than other subjects. The optional subjects had fewer numbers of teachers. It is noteworthy that there were teachers in secondary schools whose one of the subject specializations were no longer offered in the new curriculum. Thus these teachers were teaching only one subject instead of two subjects at the secondary school level.

4.2.7 Secondary School Teachers Composition by Age and Gender

The distribution of teaching workforce by age may provide a basis of assessing how acute retirement related shortages are likely to be in the future. The proportion of teachers by gender might serve as important indicator to which extent gender issues may be targeted by any future policies. For instance the proportion of female teacher may affect levels of temporary teacher shortage related to maternity leave. Gender of teachers was also a consideration when policies relating to teacher transfers were made. This study established that there were age and gender disparity in the composition of secondary school teachers in Kenya as shown in Figures 8.

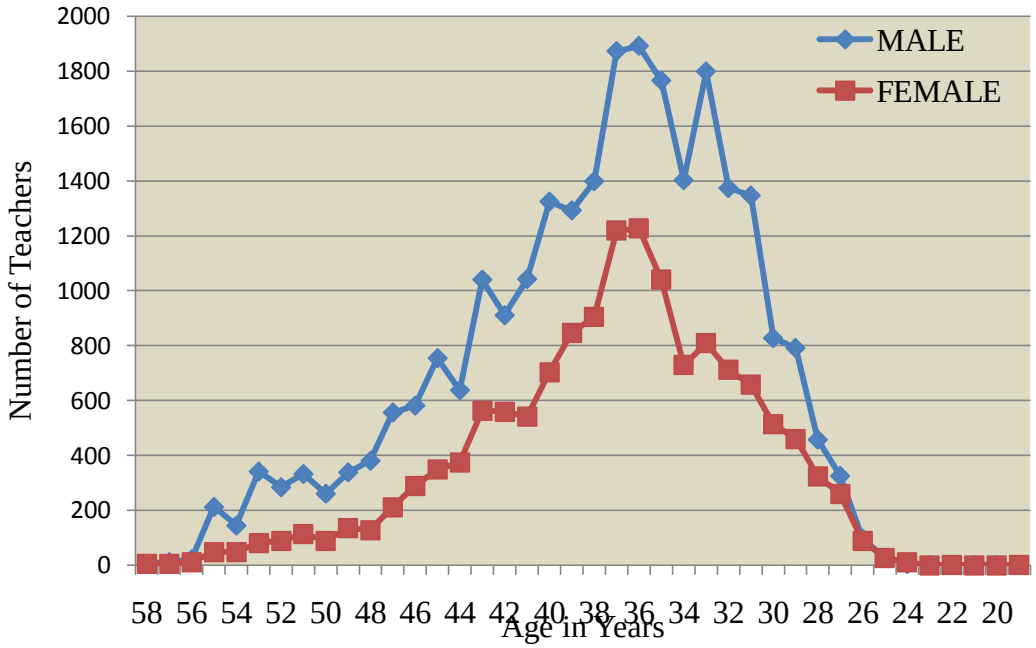

Figure 8: Teachers on Post by Age and Gender in 2007

According to 2007 statistics 65% of the teachers were male while 35% were female. Thus the secondary school teaching profession in Kenya was male dominated. This result agreed with an earlier study by TSC (2005) which indicated 65.5% of secondary school teachers as male and 34.5% as female. The study also established that most secondary school teachers in Kenya were either aged or aging and therefore teacher retirement is likely to be a major determinant of secondary school teacher demand in Kenya.

The main reason for this trend is the 1998 freeze of teacher employment and change in teacher recruitment policy in 2001. It must however be noted that the effect of teacher retirement on teacher demand will not be felt in the next five years from 2009 to 2014 due to the extension of the retirement age of all civil servants including teachers from fifty five (55) years to sixty (60) years.

The findings of this study also revealed that there were gender disparity by subject specialization with male dominating in almost all subjects apart from Home Science and Religion as shown in Table 8. It is noteworthy that male dominates in science subjects with female specializing mostly in languages and Social Sciences.

Table 8: Teacher Distribution by Subject and Gender 2007

Subject	Male	%	Female	%
Accounting	223	0.9	78	0.5
Agriculture	1874	7.2	838	5.8
Arabic	13	0.0	1	0.0
Biological Sciences	68	0.3	40	0.3
Biology	2272	8.7	1214	8.3
Building Construction	50	0.2	5	0.0
Business Education	912	3.5	329	2.3
Chemistry	1862	7.1	751	5.2
Christian Religious Education	584	2.2	989	6.8
Commerce	265	1.0	106	0.7
Computer Studies	43	0.2	22	0.2
Drawing & Design	60	0.2	11	0.1
Economics	544	2.1	114	0.8
Electricity	41	0.2	4	0.0
English	3141	12.1	3000	20.6
Fine Art & Design	55	0.2	34	0.2
French	71	0.3	68	0.5
Geography	1747	6.7	1062	7.3
Germany	11	0.0	9	0.1
Hindu Religious Education	3	0.0	1	0.0
History & Government	1707	6.6	1374	9.4
Home Science	81	0.3	713	4.9
Industrial Education	15	0.1	2	0.0
Islamic Religious Education	46	0.2	10	0.1
Kiswahili	3109	11.9	1938	13.3
Library Science	0	0.0	0	0.0
Mathematics	4955	19.0	1402	9.6
Metal Work	15	0.1	0	0.0
Music	162	0.6	76	0.5
Physical Education	29	0.1	38	0.3
Physical Sciences	2	0.0	2	0.0
Physics	1949	7.5	265	1.8
Social Education & Ethics	9	0.0	24	0.2
Typewriting & Office Practice	22	0.1	15	0.1
Power Mechanics	34	0.1	7	0.0
Wood Work	68	0.3	5	0.0

Source: TSC Records, 2008

4.2.8 Secondary School Teacher Attrition

The study established that teacher attrition has been increasing over time from 3849 teachers in 1996 to 8298 in 2007 an increase of 115.6%. It is worth noting that the average yearly increase in teacher attrition between 1996 and 2007 was 14.6% while the average increase in

number of teachers employed was 5.2%. This was an indication that the rate of teacher attrition was higher than the rate of teacher employment and thus contributing to teacher shortage.

Teachers retirement was established to be the dominat contributing factors to teacher attrition contributin to 69% of the attrition, deaths contributed to 18% of the attrition while resignation and dismisal contributed to 13% of the attritions. Information collected from staffing officers indicated that teachers turnover was highly affected by the academic field. Mathematics and sciences are found to be the fields of highest turnover as teachers resigned to move to better paying employment. These findings are in agreement with earlier studies (Murnane *et al*., 1991; Murnane, Singer, & Willet, 1888) that teachers turnover is strongly affected by the academic field.

Table 9: Rate of Secondary School Teacher Attrition and Rate of Teacher Employment in Kenya from 1996 to 2007

YEAR	Attrition	Percentage Increase in Attrition	Number of Teachers Employed	Percentage Change in Teachers Employed
			4420	
1997	3849	61.90%	4267	-3%
1998	5059	31.40%	0	-1%
1999	6079	21.20%	0	0%
2000	5069	-16.60%	0	0%
2001	4537	-10.50%	4095	1%
2002	4927	8.60%	5356	30.80%
2003	7491	52%	7464	39.40%
2004	6191	-17.40%	9844	31.90%
2005	8546	38%	6683	-32.10%
2006	6241	-27%	6901	3.30%
2007	8298	33%	6370	-7.70%

Source: TSC, 2008

Results from this study indicated a U-shaped relationship between age and teacher retention. In the early years of employment the attrition is high as entering teachers realise the occupation was not offering what they had expected or teachers change career and move to other more attractive fields while others resign to undertake further studies. The attrition is also high among older and more experienced teachers as they reach retirement age. This is a confirmation that many teachers enter the teaching carreer as a stepping stone to better paying employment.

4.2.9 Number of Teachers Employed

Trends of the number of secondary school teachers employed in public secondary schools from 1990 to 2007, shows that employment of teachers in Kenya has not been steady as show in Figure 9. The highest number of secondary school teachers employed was recorded in 1990 when the Government employed all Bachelor of Education graduates from the public universities. The number of B.Ed graduates was notably higher in 1990 due to the effect of the 1987 double intake of the 1985 and 1986 A-level groups. A similar high employment was recorded in 1993/1994 following the employment of 1990 double intake graduates of the last A-level group and the first 8-4-4 group. A similar high employment was recorded in 2002 after the Government rifted the freeze of employment of teachers and resulted to demand driven approach in hiring teachers in 2001.

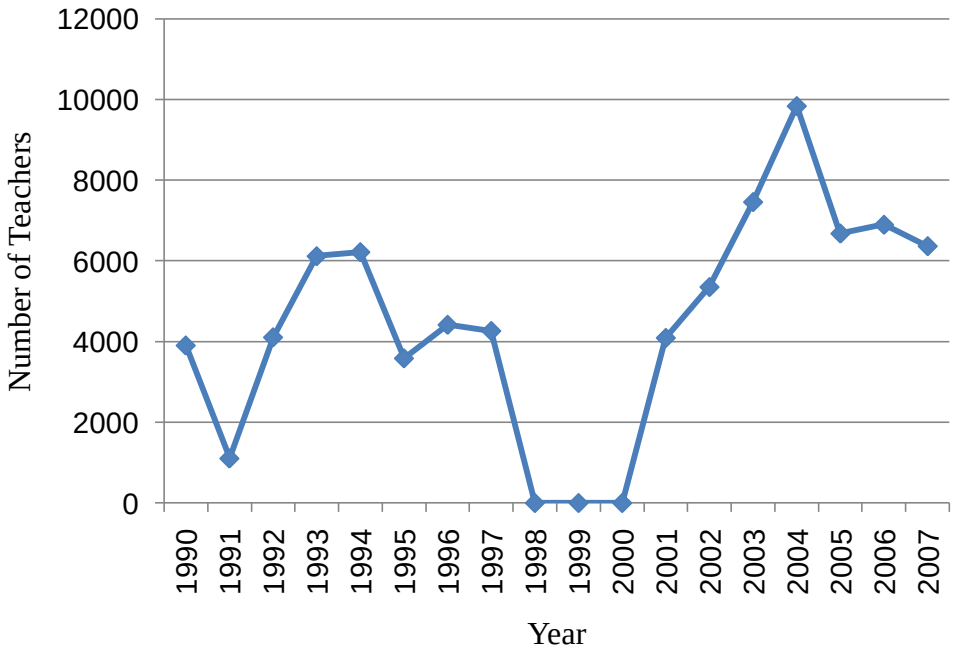

Figure 9: Number of New Teachers Employed by TSC from 1990 – 2007

The number of secondary school teachers employed varies with subject as shown in Table 10. This was more evident with the change of secondary school curriculum in 2003 which saw the reduction in the number of subjects offered from 35 to 21. As a result some subjects offered in secondary schools were removed from the curriculum and the respective teachers were assigned less workload and therefore, were underutilized. The compulsory subjects, including English and Mathematics seem to be getting the lion share of new employment

followed by optional subjects such as Biology, Chemistry and Geography while some subjects including Germany, Music and Art and Design received least teachers. It should be noted that, Germany, Music and Art and design subjects were optional subjects and were taken by very few students.

Table 10: Number of New Teachers by Subject Employed in Public Secondary Schools 2004 – 2008

Subject	2004	2005	2007	2008
Agriculture	91	139	215	312
Biology	88	335	431	640
Business Studies	31	113	215	292
Chemistry	127	422	473	710
Christian Religious Education	20	69	179	507
Computer Studies	1	12	85	87
English	236	287	328	708
Fine Art and Design	0	0	0	5
French	6	12	13	14
Geography	25	117	228	452
Germany	3	0	0	0
History and Government	22	87	188	496
Home Science	10	1	12	33
Islamic R.E.	3	5	14	27
Kiswahili	133	306	344	591
Mathematics	154	400	669	1075
Music	0	0	3	6
Physics	124	236	368	614
Arabic	0	7	13	14
TOTAL	1075	2548	3778	6583

Source: TSC Records, 2008

The study established that there has been a regional disparity in the number of teachers employed in secondary school in Kenya. The number of teachers hired in any region from 2001 to the present is an indication of the level of teacher shortage in that region since the process in demand driven. It was clear from Table 11 that, some provinces, including Rift Valley, Nyanza and Western had been having more serious teacher shortage than other regions.

Table 11: Number of Teachers Employed in Public Secondary Schools 2004 - 2007

	Central	Nairobi	Coast	Western	Rift Valley	Eastern	Nyanza	North Eastern	Total
2004	217	0	56	136	211	190	245	20	1075
2005	372	0	192	314	607	368	653	42	2548
2007	479	0	163	349	972	808	942	65	3778
Total	1068	0	411	799	1790	1366	1840	127	7401
Percentage	**14.4%**	**0.0%**	**5.6%**	**10.8%**	**24.2%**	**18.5%**	**24.9%**	**1.7%**	

Source: TSC Records, 2008

4.2.10 Secondary School Teacher Workload

Before the introduction of 8-4-4 System of Education in Kenya in 1984 the Kenya education system was that of 7-4-2-3. In the 8-4-4 system, the student undertook 8 years of primary education, 4 years of secondary education and 4 years of university education. In the 7-4-2-3, the students went through 7 years of primary education, 4 years of secondary education, 2 years of higher secondary level education and 3 years of university education. In the 7-4-2-3 system of education the staffing norm in secondary schools was determined by one and a half teachers per class. On introduction of 8-4-4 system of education, teacher requirements in secondary schools were determined by Curriculum Based Establishment (CBE) with 27 periods lasting 40 minutes each per week as the divisor per teaching post. This translated to 18 hours of teaching per week. There is also time allocated for administrative duties such that the teaching load for head teachers, deputies and head of departments are lower than the 27 lesson (18 hours) per week norm depending on the number of streams in the school. Table 12 summarizes the teaching load based on CBE and the number of streams in a school.

Table 12: Weekly Teaching Load Based on CBE and Number of Streams

Teacher Post	Number of lessons Single Stream	Number of lessons Double Stream	Number of lessons Triple Stream and above
Head Teacher	10-12	8-10	6-8
Deputy Head teacher	20-24	15-18	12-15
HOD – Job Group N	20-24	15-18	18-20
HOD – Job Group M	20-24	20-24	20-24
Teacher	27	27	27

Source: MoE, Circular No. CIS 2/2003

The study observed that the average contact hours for secondary school teachers in Kenya in 2007 was 22 lessons (15 hours) per week (TSC, 2008). This is lower than the recommended 27 lessons per week. Thus teacher in secondary school in Kenya were under utilized. It is therefore possible to reduce teacher shortage in Kenyan secondary school by a large margin by redistributing teachers effectively among the public secondary schools and ensuring that each teacher covers the minimum workload required of 27 lessons per week. Thus it was possible to reduce the teacher shortage in secondary schools by 6564 teachers by only equitably redistributing the teachers and ensuring that all teachers teach the recommended minimum 27 lessons per week.

4.2.11 Trends in Secondary School Teacher demand and Supply

Mismatch between demand and supply of secondary school teachers in Kenya is a phenomenon that has been experienced for a long period of time as shown in Figure 10. Perhaps the mismatch became more pronounced after 1984/1985 with the introduction of 8-4-4 system when the first primary school graduates of the new system entered secondary schools. There was an abrupt demand for more teachers to teach the new subjects introduced by the new system of education at the secondary school level. The problem of demand and supply of secondary school teachers was even more aggravated in 1987/1988 with a Government policy of converting all the former harambee school to public schools. Since there were no enough trained secondary school teachers, the Government resorted to employment of untrained teachers (Otiende *et al.*, 1992).

By 1989 and based on the CBE formulae, the secondary school teacher demand and supply mismatch was evident across subjects as shown in Table 13. While there was over supply in some subjects, including History and Geography there were critical shortages in other subjects especially in sciences and languages including Physics, Chemistry, Biology, Agriculture, English and Kiswahili. The Government decision to phase out all diploma colleges producing art based graduates in 1990 was perhaps meant to correct this trend.

An examination of the trend in secondary school teacher demand and supply shows that the mismatch that prevailed in the 1980s still persists up to the present. There are points where the secondary school teacher labour market reached near equilibrium. In 1990s there was a point of teacher demand-supply equilibrium after the Government took over the former

harambee schools, all the teachers who had been produced from colleges and universities, but not employed were employed by the Government to be posted to the former harambee schools. Those teachers who were teaching in the harambee schools were also absorbed by the Government. During the same period many diploma secondary school teachers for Geography, History and CRE were moved from secondary school to primary school to avoid the problem of over supply.

Table 13: Demand and Supply of Secondary School Teachers in Kenya in 1989

Subject	Supply (graduating from colleges & University)	Demand	Shortage/ Surplus
Physics	34	292	-258
Accounts/Commerce	92	263	-171
Agriculture	0	148	-148
Chemistry	44	176	-132
Kiswahili	79	164	-85
English	82	156	-74
Woodwork	0	66	-66
Biology	98	140	-42
CRE	86	121	-35
Economics	41	65	-24
Design	0	15	-15
I.R.E	0	14	-14
Fine Art	10	24	-14
Mathematics	55	62	-7
Home Science	65	71	-6
Building & Construction	0	3	-3
Metal work	0	1	-1
Music	14	4	10
French	19	8	11
Secretarial	24	2	22
History	51	19	32
Geography	49	9	40
Total	843	1823	-980

Source: TSC Records, 2007

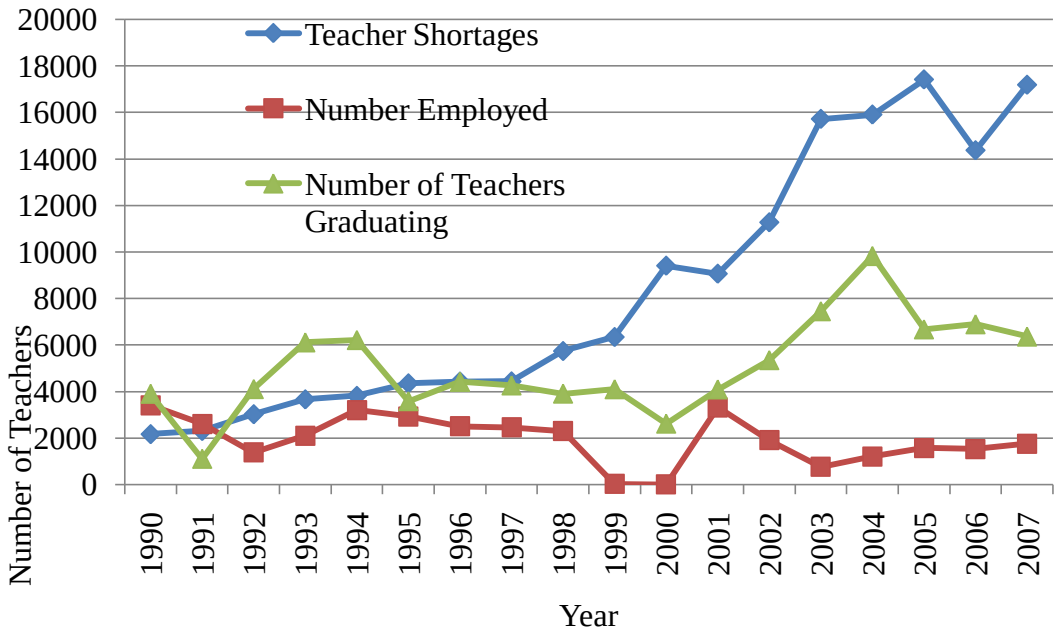

Figure 10: Number of Secondary School Teacher Employed Against the Number of Teachers Graduating from Universities and Colleges 1990- 2007

Over the study period supply was above the number of teachers employed save for a few years when near equilibrium was attained. However, as seen in Figure 10 there was a short period of over supply in 1990 and 1991 as teachers from former harambee schools were employed into the public secondary schools. This forced the government to deploy some of the diploma teachers in humanities from secondary school level to primary school level. The gap between number of teachers graduating and those employed widened in 1993/1994 when the double intake groups graduated from the universities. It is noteworthy that most of the double intake graduates were taking art based subjects, mainly history, geography and CRE leading to over supply in these subjects. The demand supply reached near equilibrium after all the double intake graduates had cleared from the universities and the production stabilized between 1995 and 2000. During this period the universities were forced by the market forces to control admissions since some of the graduates from previous years were not getting employment immediately after finishing their studies due to saturation of the labour market in certain teaching subjects specialization. The most affected were mostly B.Ed Arts graduates in History, Geography and CRE.

The Government policy to freeze employment of all civil servants including teachers in 1998 greatly affected the demand for secondary school teachers. Thus no teachers were employed between 1998 and 2000, hence widening the gap between demand and supply. However this

decision was reviewed in 2001 when the Government decided to employ teachers to replace those leaving the profession due to natural attrition. This created a near equilibrium scenario as many teachers qualified in previous years were absorbed by the TSC. However the number hired per year in the subsequent years reduced to attain a stable trend between 2003 and 2007. The demand and supply gap has been widening since 2002 with supply steadily increasing as attributed to introduction of more universities and colleges offering teacher programmes together with introduction of parallel and school based programmes in teacher education. The gap between teacher shortage and supply of graduates widened from 1997 to 2007 due to the freeze of teacher employment and change in teacher recruitment policy.

The oversupply in geography, history and CRE experienced in mid-1990s had translated to undersupply of teachers in the same subjects by the year 2003. It is also noteworthy that the increase in the supply of teachers is attributed to the prevalence of more students in the university taking bachelor of education due to its high employment prospects as compared to most other programmes where employment is not assured. Bachelors of education graduates were more likely to get employment either in the private school or in the public school as they await eventual employment by the TSC depending on their subject combination. The situation on the ground is that while the country has trained enough teachers in certain subjects, the schools continue to suffer from lack of enough teachers in some subjects. The main problem is that the attempts by the Government to control the wage bill and this may explain why there were many qualified graduate teachers who were not employed. As a result many schools were forced to hire these teachers under BOG to cater for the shortfall.

4.2.12 Secondary School Teacher Demand by Subject

From data collected from 351 sampled public secondary schools for this study in 2007 there was a teacher shortage 1846. The highest teacher shortage was in History, Computer, Geography and CRE as shown in Table 14. The picture is in contrast to the situation in the mid 1990s when teachers in those subjects were in over supply. In the early 1990s the MoE transferred a large number of Art based diploma teachers from secondary schools to primary school level. It is worth noting that the teacher shortage indicated here is at the school level and not necessarily at the market level, and thus the problem of teacher shortage in secondary schools in Kenya is due to the problem of employment because there were unemployed teachers in the market with the subject combinations needed in the secondary schools.

According to information obtained from the staffing officers, despite the teacher shortages in secondary schools, most of the public schools were able to cope by hiring teachers through the Board of Governors (BOG Teachers) and paying them with the school resources.

Table 14: Secondary School Teacher Shortage by Subject 2007

Subject	Teacher Shortage	Supply
Geography	375	222
History and Government	372	124
Computer Studies	324	3
Agriculture	310	127
CRE	50	128
Physics	33	337
English	22	432
Biology	20	446
Kiswahili	19	202
Chemistry	17	465
Mathematics	15	750
Commerce	13	186
Business Studies	11	91
Music	6	8
Arabic	5	12
German	5	15
Home Science	5	28
Power mechanics	4	5
Drawing and design	4	0
French	3	7
Islamic Religious Education	3	11
Type writing	3	0
TOTAL	**1619**	**3591**

Source: TSC Records, 2008.

4.2.13 Teacher Demand by Province

The study also revealed regional disparity in the demand and supply of secondary school teachers in the country with the highest relative overstaffing being experienced in Central, Nairobi and Eastern provinces while the larger relative understaffing being experienced in Nyanza, Rift Valley and Western provinces. Table 15 shows secondary school teacher staffing gaps by province in 2004.

Evidence from TSC schools returns 2004 indicated that both under supply and over supply co-exist in Kenya secondary schools. At the National level there was under-staffing of 6,226

teachers against over staffing of 1,535 teachers. The TSC staffing officers indicated that it was difficult to attain perfect teacher distribution in the country because teacher distribution was affected by many issues including governance, social issues and political patronage. Thus the problem of teacher shortage in secondary schools could have been reduced by redistribution and effective utilization of existing teachers.

Table 15: Secondary School Teacher Staffing Gap by Province in Kenya in 2004

Province	Teachers in Post	Number of Teachers Expected based on CBE	Over Staffing	Under Staffing
Coast	1750	1980	41	271
Central	9510	10170	413	1073
Eastern	7304	8204	302	1202
Nairobi	797	647	150	0
Rift Valley	7583	8897	298	1612
Western	4926	6231	133	1438
Nyanza	6787	8750	190	1963
North Eastern	282	286	8	4
National Total	38,939	45,165	1535	6,226

Source: TSC Records, 2007

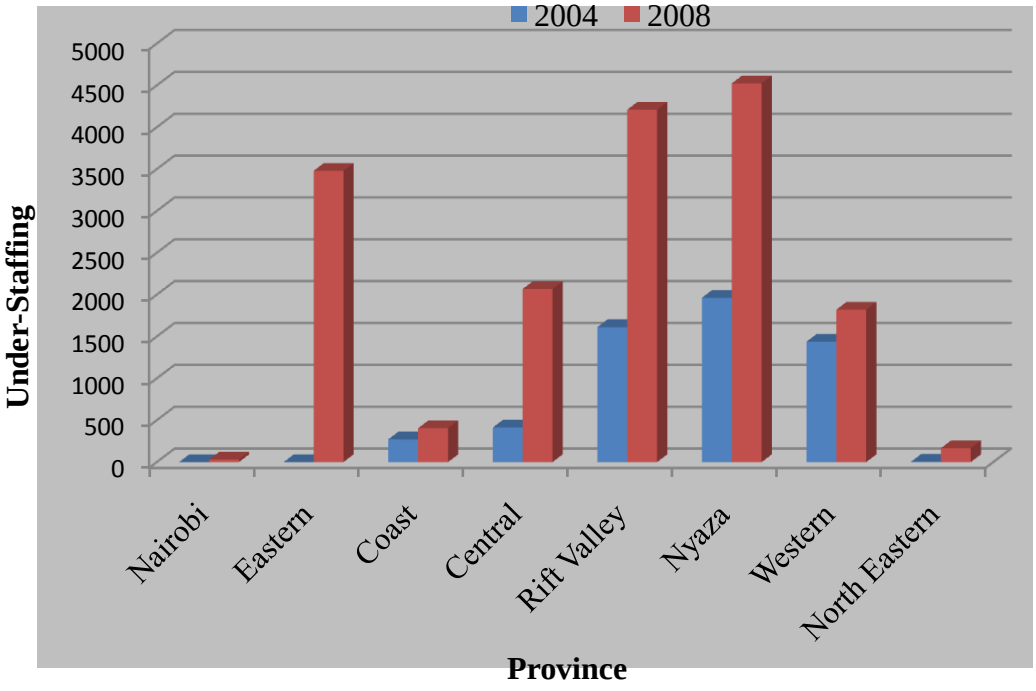

Figure 11: Secondary School Understaffing in Kenya 2004 and 2008

The results from the study indicated that understaffing in secondary schools varied with time and by province. Comparison between 2004 and 2008 under-staffing levels revealed that the

problem was more critical in 2008 as compared to 2004 (Figure 11). The greatest variations are recorded in Eastern, Rift Valley and Nyanza provinces. This is an indication that the teachers planning and distribution methods are not efficient.

4.2.14 Secondary School Curriculum

The secondary school curriculum has been changed over time and this has greatly contributed to the change in demand for teachers in various subjects. The revised curriculum currently in use in secondary schools came to effect in 2003, starting with the Form one class and the implementation of the last phase was completed in 2006 when the first batch of students using the new curriculum reached Form four (MOEST, Circular No. CIS 2/2003). The main changes in the new curriculum were to cut down costs by reducing the number of subjects, to rectify overloading in certain subjects and overlap within and across subjects by removing the unnecessary content and introducing new contents and emerging issues, such as HIV/AIDS which were integrated in the curriculum (TSC, 2005). Tables 16 and 17 show the current secondary school curriculum indicating both the core subjects and the elective subjects.

Table 16: The Current Secondary School Curriculum Matrix for Form 1 and 2

Core subjects	**Number of lessons per week**
English	6
Mathematics	6
Kiswahili	5
Biology	4
Physics	4
Chemistry	4
Geography	3
History and Government	3
Religious Education (CRE, IRE, HRE)	3
Physical Education	1
Optional Subjects	
Agriculture	3
Home Science	3
Business Studies	3
Computer Studies	3
Music	3
Art and Design	3
Foreign Languages (Arabic, French and Germany)	3

Source: MOEST, Circular No. CIS 2/2003

In the new rationalized curriculum, the number of subjects on offer in most of the secondary schools was reduced from 35 to 21. Thus there is a number of secondary school teachers whose subjects were no longer in secondary school curriculum. While many of the affected

teachers were transferred to other areas where they subject combinations were relevant including teachers training colleges and technical training colleges, there are a number of teachers who remained with one teaching subject at the secondary school level and therefore these teachers are being underutilized. The affected teachers were mostly those offering teaching technical subjects such as metal work, electricity, power mechanics, economics, commerce, accounting, woodwork and typing with office practice.

Table 17: The current Secondary School Curriculum Matrix for Form 3 and 4

Core subjects	**Number of lessons per week**
English	8
Mathematics	7
Kiswahili	6
Optional Subjects	
Biology	5
Physics	5
Chemistry	5
Geography	5
History and Government	4
Religious Education (CRE, IRE, HRE)	4
Physical Education	2
Agriculture	4
Home Science	4
Business Studies	4
Computer Studies	4
Music	4
Art and Design	4
Foreign Languages (Arabic, French and Germany)	4

Source: MOEST, Circular No. CIS 2/2003

4.3 The Effects of Selected Factors on Teacher Demand

This section presents the findings that answers the second research question which seek to establish the effects of the selected factors on secondary school teacher demand. Thus the section describes the selected factors, test of suitability of Poisson Regression and the effects of the selected factors on teacher demand.

4.3.1 Factors Determining Secondary School Teacher Demand

A number of selected factors were explored in this study to establish their effect on secondary school teacher demand in Kenya. The factors were entered into Poisson regression to generate secondary school teacher demand model. Poisson regression was found appropriate in this study because the teacher demand factors under investigation were counts, the data in one school were independent from data collected from other schools and the distribution of

the data for teacher demand factors was not normal. The demand factors entered into the Poisson regression model included: number of teachers on duty, secondary school enrolment, secondary school student teacher ratio (PTR), class size, number of streams, teacher workload and Government policy.

4.3.1.1 Test for Suitability of Use of Poisson Regression

The dependent and the independent variables for this study were subjected to Dagostino Pearson Test and Shapiro-Wilk W Test for normal data to determine the suitability for Poisson regression which was used in this study. The data were also plotted in form of histograms to visualize the skewness of the distribution.

Understaffing was used as an indicator of teacher demand and therefore it was the dependent variable in this study. Results from Dagostino Pearson Test and Shapiro-Wilk W Test for normal data and the histogram indicated that the data for understaffed was not normal. The p-value from the Dagostino Pearson test was less than 0.05 (P-value = $1.343e\text{-}^{08}$) while the P-Value for Shapiro-Wilk W Test was 0.0. The P-value for both tests was therefore clearly significant at 0.05 significance level which rejects the null hypothesis that the data were from a normal distribution. Thus the conclusion was that the distribution for understaffing data was not normal. To explore the data further understaffing was transformed using the log function. Similarly, both the histogram and Dagostino Pearson test (p-value = 1.064e-10) showed that even the transformed data for understaffing were not normal. The histogram for the understaffing was not symmetrical which shows that the distribution was not normal. Therefore the use of Poisson distribution for understaffing data was appropriate.

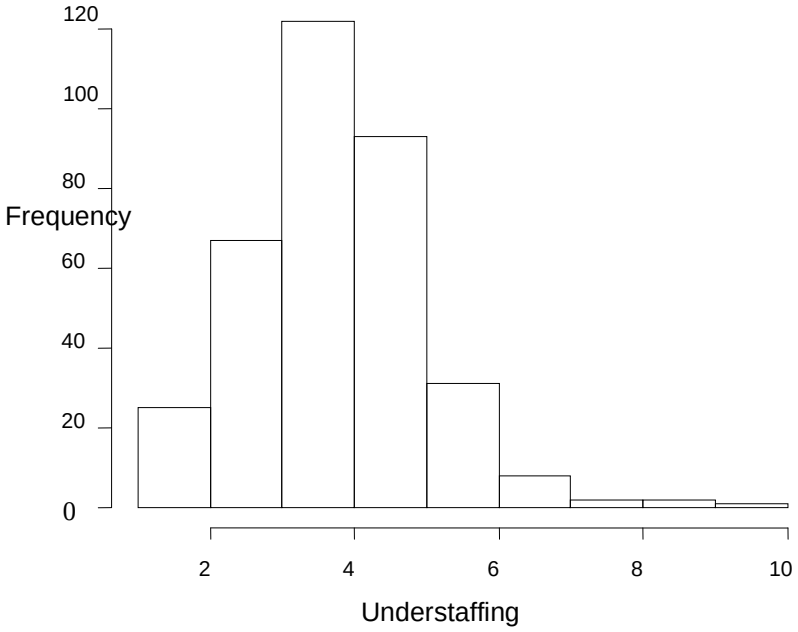

Figure 12: Histogram showing the Distribution of Understaffing Data

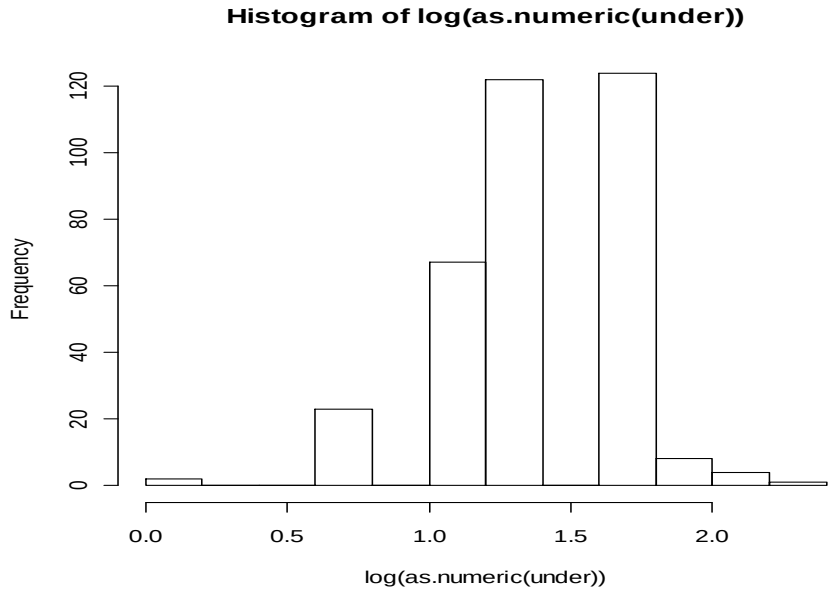

Figure 13: Histogram Showing the Distribution of Transformed understaffing Data

The data independent variables in this study including number of teachers on duty, student enrolment, PTR, class size, number of teachers employed and teacher workload were subjected to Dagostino Pearson Test and Shapiro-Wilk W Test for normal data. The Dagostino Pearson Test (Table 18) and Shapilo-Wilk W tests results (Table 19) for all the

independent variable showed that the P-values were significant at 0.05 an indication that the data for all the independent variables was not normal. The histograms for all the independent variable (Figure 14 & 15) were also not symmetrical and were skewed to the left a further confirmation that the data were not normal and therefore the use of Poisson distribution was appropriate.

Table 18: Diagnostic Results for Dagostino Pearson Tests of the Variables

Variable	Observations	P-Value
Understaffing	351	$1.343e-^{08}$
Number Employed	351	2.2e-16
Numbers of Teachers on Duty	351	3.933e-16
PTR	351	2.2e-16
Average Teacher Workload	351	0.0004594
Average Class Size	351	2.2e-16

Table 19: Diagnostic Results for Shapiro-Wilk W Test for Normal Data

Variable	Observations	W	V	z	Prob>z
Understaffing	351	0.96638	8.235	4.986	0.00000
Number Employed	351	0.97205	6.830	4.543	0.00000
Numbers of Teachers on Duty	351	0.90290	23.786	7.495	0.00000
PTR	351	0.83959	39.294	8.682	0.00000
Average Teacher Workload	351	0.98335	4.078	3.324	0.00000
Average Class Size	351	0.88686	27.715	7.856	0.00000

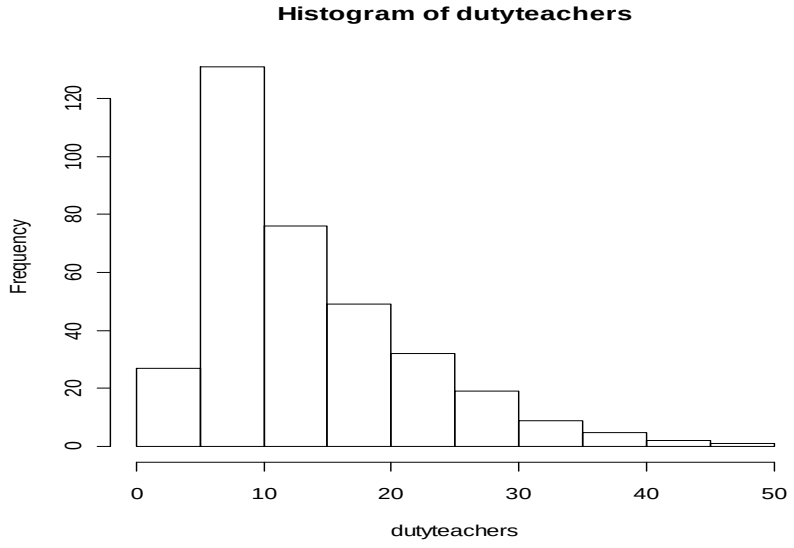

Figure 14: Histogram Showing the Distribution of Teachers on Duty Data

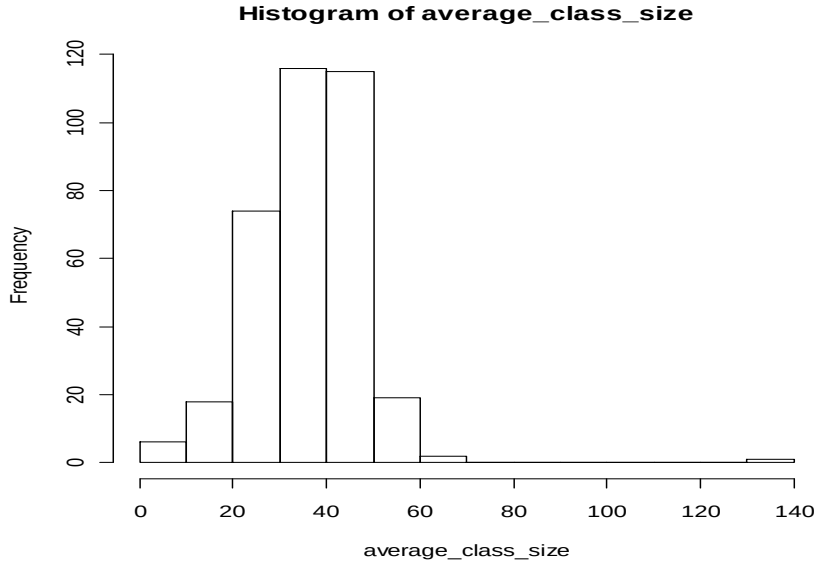

Figure 15: Histogram Showing the Distribution of Average Class size Data

4.3.2 Effects of the Selected Factors on Teacher demand

The selected factors were subjected to Poisson regression to determine their effect on teacher demand. The results of the Poisson regression are presented in the model.

Table 20: Secondary School Teacher Demand Model

Understaffing	Coefficient	Standard Error	P>|z|
Number of Teachers on Duty	-0.0350	0.0142	0.0140
Student Enrolment	0.0021	0.0008	0.0110
PTR	0.0025	0.0053	0.6420
Number of Classes	0.0103	0.0550	0.8520
Number of Streams	-0.1070	0.2381	0.6530
Average Class Size	-0.0160	0.0063	0.0110
Number of Teachers Employed	0.2396	0.0835	0.0040
Teacher Workload	0.0024	0.0104	0.8190
Policy	0.0359	0.1293	0.7810
Constant	1.1094	0.3341	0.0010

The results showed that the model on secondary school teacher demand was fitting (P-value = 0.00, R^2 =0.50). Thus the conclusion was that the independent variables influence the change in dependent variable was significant. Results of the Poisson Regression showed that the significant factors determining secondary school teacher demand in Kenya included: number teachers on duty (P-value = 0.014), secondary school enrolment (P-value = 0.011), class size (P-value = 0.011) and number of teachers employed (P-value = 0.004). The data collected

provided evidence to prove that the following factors did affect secondary school teacher demand collectively although they did not have significant effect of teacher demand independently; PTR , number of classes, number of streams, teacher workload and Government policy. The factors were subject to further analysis to establish whether the inclusion of interaction terms was significant. The inclusion of interaction term into the model yielded the results in Table 21.

From the Poisson regression results it was clear that inclusion of the interaction terms into the model is insignificance (Prob > chi2 = 0.1798), hence the study concluded that the simple linear model:

$$Ln(y) = a + bx_1 + cx_2 + dx_3 + ... + \varepsilon \quad \text{Equation } \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

was the most appropriate model for projecting secondary school teachers in Kenya.

where: y = teacher demand

a = Constant

x_1= Number of teachers on duty

x_2 = Student enrolment

x_3 = PTR

x_4 = Number of Classes

x_5 = Average class size

x_6 = Number of streams

x_7 = Number of teachers employed

x_8 = Average teacher workload

X_9 = Government policy

Table 21: Teacher Demand Model with Interaction of the Selected Factors

Understaffing	Coefficient	Std Error	P>|z|
Number of Teachers on Duty	-0.0635	0.0368	0.0840
Student Enrolment	0.0021	0.0017	0.2300
PTR	0.0056	0.0056	0.3170
Number of Classes	0.0050	0.0564	0.9290
Number of Streams	0.0030	0.2707	0.9910
Average Class Size	-0.0226	0.0095	0.0180
Number of Teachers Employed	-0.0596	0.2616	0.8200
Teacher Workload	0.0007	0.0104	0.9430
Policy	0.0504	0.1529	0.7410
Teachers on Duty x Student Enrolment	0.0000	0.0000	0.7510
Teachers on duty x number of teachers employed	0.0001	0.0010	0.8930
Average class size x number of teachers employed	0.0355	0.0126	0.0050
Student enrolment x number of teachers employed	0.0047	0.0068	0.4890
Student enrolment x average class size	-0.0013	0.0006	0.0370
Constant	0.0000	0.0000	0.4530

4.3.2.1 Number of Teachers on Duty

This study established that the number of teachers on duty was a significant factor (P-value = 0.014 at 0.05 significant level) determining secondary school teacher demand. However the number of teachers on duty had a negative influence on teacher demand. Thus the more the number of teachers on duty, the lower the teacher demand. The number of teachers in public secondary schools in the country increased from 28056 in 1990 to 44305 in 2007 an increase of 58% over the period. It was observed that the increase in number of teachers on duty in public secondary schools was not steady over the study period. The freezing of teacher employment in 1998 and the change in teacher recruitment policy in 2001 had a large effect on teacher demand. Thus from 1998 to 2000, there was no teacher employment thus increasing teacher demand. From 2001, the TSC changed teacher recruitment policy from supply driven to demand driven by recruiting teachers where demand exists. However, the new policy had not been effective due to the fact that the TSC had not been able to meet teacher demand in all the secondary schools and teacher shortages still existed. The explanation to this was that although the TSC had planned to implement the demand driven approach, in practice only teachers leaving the profession through natural attrition were replaced because the Government has not allocated enough money to hire the teachers to meet the demand. Indeed there has been pressure from the IMF and World Bank on the Government to reduce the civil servants wage bill including teachers wage bill. Teacher

shortages in public secondary schools are likely to have a negative impact of quality of education and delay the attainment of the Vision 2030 goal in education of providing high quality education to the citizens.

4.3.2.2 Secondary School Student Enrolment

This study established that student enrolment at secondary school level had a significant effect on teacher demand (P-value = 0.011). The effect of student enrolment on teacher demand was in the positive direction indicating that an increase in enrolment results to an increase in teacher demand. The number of secondary school students increased from 618500 in 1990 to 1180300 in 2007, an increase of 90.8%. Student enrolment at the secondary school level in Kenya is expected to rise as more graduates from FPE join the secondary school level as well as increased enrolment due to introduction of FSE. Some of the strategies under Vision 2030 in education is to increase the transitional rate from 60% in 2007 to 75% by 2012 and build 560 new public secondary schools by 2012. Therefore, there are indications that secondary school enrolment is likely to raise in future and therefore the need for a framework to project teacher demand. The teacher demand projection model developed in this study is therefore, expected to guide the policy makers.

4.3.2.3 Class Size

This study established that class size had a significant influence (P-value = 0.011) on teacher demand. The average class size had a negative effect on teacher demand indicating that an increase in class size resulted to a reduction in teacher demand. The findings established that the average class size in public secondary school in Kenya was 37 which was below the optimum class size of 40 and Ministry of Education recommended 45 students per class. Thus the teacher resources in most of the public secondary schools were under utilized. It is therefore possible to increase class sizes to meet the increasing student enrolment without the need for more teachers.

4.3.2.4 Number of Secondary School Teachers Employed

The findings of this study indicated that number of teachers employed had a significant effect (P-value = 0.004) on teacher demand. The study established that on average 4470 new secondary school teachers are employed every year at the national level during the study period. However, the recruitment of new teachers was not steady and seemed to be done in an

unplanned manner without a clear framework. The number of teachers employed in Kenya was influenced by various factors some of which were beyond the control of the Ministry of Education and the TSC. There was no employment of new teachers at the secondary school level as a result of 1998 freeze on teacher employment a result of the pressure by IMF and World Bank on the Government to reduce the civil servant wage bill including that of teachers. From 2001, the TSC started employing new teachers to replace those leaving the teaching profession due to natural attrition. However, the recruitment of new teachers, though expected to be demand driven, does not meet the required demand due to the limited allocation on the part of the Government to hire adequate teachers. In line with Vision 2030 in education the Government plans to employ more teachers in primary and secondary education.

4.3.2.5 Number of streams

This study established that number of streams in a school had a negative effect on teacher demand when combined with other factors. On average, most of the public secondary schools had two streams in 2007. The findings of this indicated that increasing the number of streams at the school level would reduce teacher demand. A study by Olel and Othuon (2005) recommended that public secondary schools should strive to attain a minimum of three streams as a way of increasing enrolment and improve the utilization of resources at the school level while benefiting from economies of scale.

4.3.2.6 Secondary School Teacher work load

The findings of these study indicated that teacher workload had a positive effect on teacher demand when combined with other factors. Evidence from this study indicated that secondary school teachers on average teach 22 lessons per week which is lower than the recommended 27 lessons per week. Earlier studies had shown that the actual and recommended contact hours in Kenya were lower than contact hours in other African countries. For instance, the average teaching hours in Ghana and Mozambique are 25 and 24 respectively. Comparing Kenya with Asia and European countries show that the actual and recommended teaching load for Kenyan teachers was lower (Siniscalco, 2002). Thus secondary school teachers in Kenya were under utilized. This lower teacher workload contradicts the teacher shortage experienced in some subjects due to structural imbalances in the demand and supply of secondary school teacher.

4.3.2.7 Government Policy

The findings of this study established that Government policy had a positive effect on teacher demand. Thus the Government policy changes had profound effect on teacher demand in Kenya secondary schools. For instance, the decision the Government in 1987/1988 to convert Harambee secondary schools to public secondary schools and that these schools be provided with full employment of teachers caused the Teachers Service Commission (TSC) to absorb all the teachers who had hitherto been under the Board of Governors. One of the effects of these move was that Mathematics, Science and Languages teachers who were in short supply , and who had been posted to Government maintained schools had now to be shared among the former harambee schools which had become public leading to teacher shortage in these subjects (Kang'ali, 1994).

The decision by the Government to freeze employment of civil servants, including those of teachers in 1998 increased secondary school teacher demand since no teachers were employed in public secondary schools from 1998 to 2000. The change in teacher recruitment policy from supply driven to demand driven approach in 2001 also affected teacher demand at the secondary school level. Since 2001, teacher recruitment in public secondary schools is done at the school level based on the new policy.

The Government policy to introduce free primary school in 2003 and free secondary education in 2008 has already brought in changes in the demand for secondary school teachers resulting from increased enrolments in these levels. However most of the policies seem to be done without proper planning. Most of these policies also seem to be politically motivated rather than being influenced by planners.

The decision by the TSC in 1996 to pay extra allowances to attract teachers in some subjects namely; mathematics and sciences (chemistry, biology and physics) resulted in more teacher trainees enrolling in these subjects. In 1997 languages (English and Kiswahili) were included but the humanities were left out and as a result fewer teacher trainees were undertaking humanities as their subjects of choice.

Lack of clear policy guidelines on starting of new schools has resulted to mushrooming of many new schools usually established through political influence and funded by Constituency

Development Funds (CDF). Some of these school are not viable since they are under-enrolled and suffer from teacher shortage since they have failed to meet the set criteria to be supplied by teachers from TSC. There is therefore the need for a policy governing the establishment of new schools based on hinterland projected enrolments and capacity of existing schools in the area.

4.3.2.8 Teacher Demand Factors with Province Fixed Effect

The teacher demand factors were subjected to Poisson regression with province as fixed effects. The comparison province was Coast province. The Poisson Regression with province as fixed effects is presented in Table 22 and Table 23.

Table 22: Results for a Poisson Model for Fixed Effects with the Comparison Province Being Coast Province.

Understaffed	Incident Relative Risk (IRR)	Standard Error	P>|z|
Prvcode_2	0.7482	0.1471	0.1400
Iprvcode_3	0.8890	0.1710	0.5410
Iprvcode_4	0.0000	0.0003	0.9770
Iprvcode_5	0.9945	0.1916	0.9770
Iprvcode_6	0.9797	0.2074	0.9230
Iprvcode_7	0.9474	0.1824	0.7790
Iprvcode_8	0.9671	0.3827	0.9330
Number of Teachers on Duty	0.9781	0.0142	0.1280
Student Enrolment	1.0018	0.0008	0.0330
PTR	1.0068	0.0054	0.2040
Number of Classes	1.0207	0.0572	0.7140
Number of Streams	0.8454	0.2045	0.4880
Average Class Size	0.9819	0.0064	0.0050
Number of Teachers Employed	1.2755	0.1110	0.0050
Teacher Workload	1.0025	0.0106	0.8140
Policy	1.0098	0.1326	0.9410

The results of the Poisson Regression model with random effect illustrated the Incidence Relative Risk (IRR) on teacher understaffing. This implied that, increase of one student in a school resulted in an increase of 1.00207 (0.21%) in the risk of teachers understaffing. An increase of 1 in PTR resulted in an increase of 1.003206 (0.32%) in the risk of teacher understaffing. An increase of one unit in teacher workload resulted in an increase of 1.00259 (0.26%) in the risk of teacher understaffing. The implication is that changing the levels in student enrolment, PTR, number of classes, number of teachers employed and teacher without relevant policy controls and interventions measures would increase the risk of teacher

shortage. Thus there is the need for the policy makers to control the effects of secondary school teacher demand factors to avoid critical teacher shortages in the future.

Table 23: Results for a Poisson model for Random effects

Understaffing	Incident Relative Risk (IRR)	Standard Error	P>|z|
Number of Teachers on Duty	0.9673	0.0140	0.0220
Student Enrolment	1.0021	0.0008	0.0130
PTR	1.0032	0.0055	0.5590
Number of Classes	1.0132	0.0563	0.8140
Number of Streams	0.8845	0.2131	0.6110
Average Class Size	0.9838	0.0063	0.0100
Number of Teachers Employed	1.2743	0.1079	0.0040
Teacher Workload	1.0026	0.0105	0.8040
Policy	1.0324	0.1343	0.8060

4.3.2.9 Province Random Effects on Teacher Understaffing

Figure 16 shows a plot for the provinces random effects that can be used to visualize teacher understaffing among provinces in Kenya based on the sample used in this study. The red line shows a balance and all regions should be close to the line if there are adequately staffed. The figure explores the variations among provinces in terms of understaffing (teacher demand). Based on the model a negative random effect indicated the level of understaffing while a positive random effect indicate the level of over staffing. The results showed that most schools in Central, Nairobi and Eastern Provinces were overstaffed with Central province having the highest level of overstaffing while Eastern province was only slightly overstaffed. The figure however indicated that most schools in North Eastern, Western, Nyanza, Rift-valley and Coast provinces are understaffed.

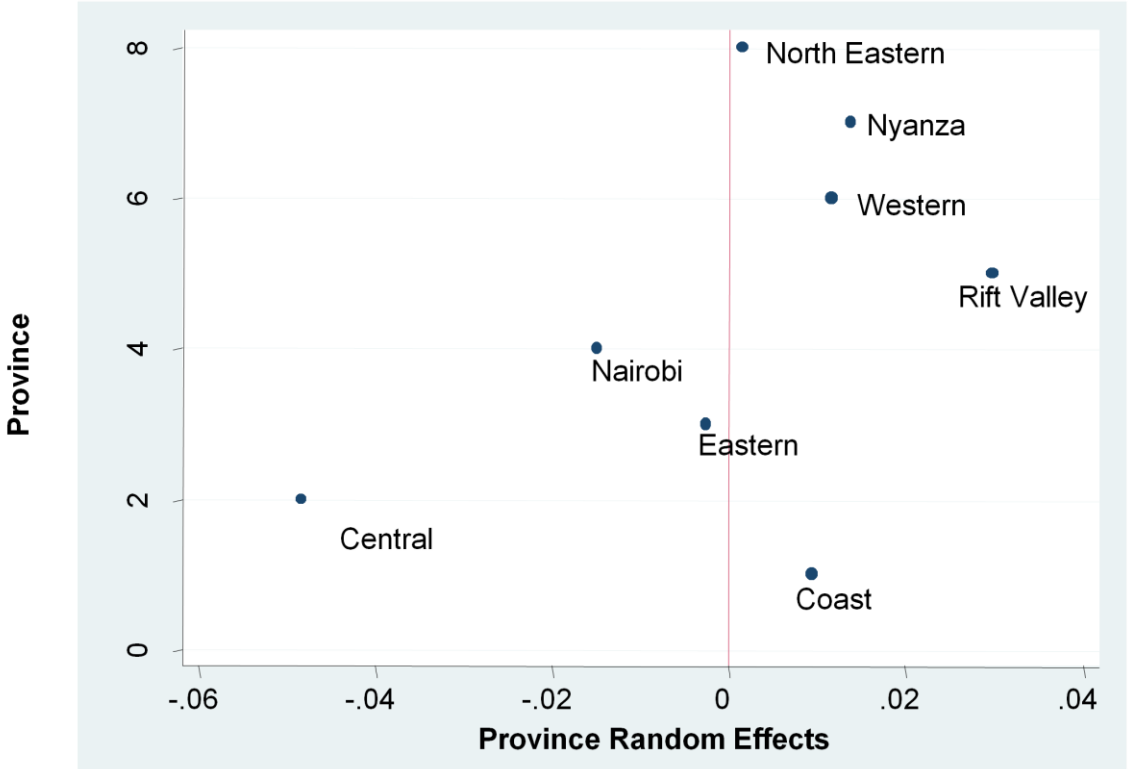

Figure 16: Distribution of Provinces Random Effects Showing Understaffing Ranking

These results can be used not only to visualise the understaffing effects at the province level but also to rationalise teacher deployment by province.

4.4 Projected Secondary School Teacher Demand

Projections were done for secondary school teacher demand based on the selected factors using Poisson Regression model. The factors included in the secondary school teacher demand model included: number of teachers on duty, secondary school student enrolment, PTR, number of classes, number of streams, average class size, number of teachers employed, average teacher workload and Government policy.

The Kenya secondary school teacher demand Poisson Regression model, represented as an expression of these factors, is as indicated in equation 3.

$$Ln(y) = a + bx_1 + cx_2 + dx_3 + ... + \varepsilon \quad \text{..... Equation 3}$$

where: y = teacher demand

a = Constant

x_1= Number of teachers on duty

x_2 = Student enrolment

x_3 = PTR

x_4 = Number of Classes

x_5 = Average class size

x_6 = Number of streams

x_7 = Number of teachers employed

x_8 = Average teacher workload

X_9 = Government policy

4.4.1 Projection of Secondary School Teacher Demand under Different Scenarios

4.4.1.1 The Concept of Scenario and Simulations.

Scenario modelling is an analytical approach to explore different future pathways or alternatives over policy issues. These different future pathways may be determined by antecedent factors (drivers) of change. Scenario analysis has been employed in many socio-economic sectors including military (Gori *et al*., 2010), business (Roubini Global Economy, 2010), industry (Australian Research Council, 2007), environment (Partnership for European Environmental Research, 2009), education (Saussois, 2006) and governance (Baltic Gateway, 2005). In education, scenario analysis can be used to explore future trends in education systems in teacher demand and supply, enrolment levels, investment in education and the contribution of education to socio-economic development among others.

In this study, scenario analysis was used to simulate projected levels of secondary school teacher demand toward vision 2030. The year 2030 was chosen due to its significance as the target year for Kenya's vision 2030. The vision aspires to have globally competitive quality education, training and research for sustainable development (GoK, 2007). The vision would require increase in the level of teacher workforce at the secondary school level, and thus the need for the education system to be more efficient in teacher management and utilization.

The teacher demand model (Equation 3) was used to simulate the levels of teacher demand from 2010 to 2030. The main drivers of change in the future teacher demand were the very factors explored in this study. These factors included:

- Number of secondary school teachers on duty
- Student enrolment
- PTR
- Class size
- Number of streams

- Number of teachers employed
- Teacher workload

The projections were made by simulations of the most significant teacher demand factors. Simulations were made based on assumptions under three possible future teacher demand scenarios namely: “Business as usual”; Worst Case Scenario”; and “Best Case Scenario”. The assumptions under each scenario dictated the trends there in. These assumptions were chosen to be internally consistent, mutually exclusive and robust between the scenarios. Table 24 summarises these assumptions.

Table 24: Secondary School Teacher Demand Projection Assumptions under Different Scenario

	Scenario		
Assumptions	**Business as Usual**	**Best Case Scenario**	**Worst Case Scenario**
Teacher Recruitment	Ad hoc teacher recruitment. Limited teacher recruitment mainly only replace teachers leaving the profession through natural attrition	Government employs teachers based on demand	Freezing of teacher employment
Teacher Utilization	Teachers under utilized	Optimum Workload	Teacher under utilized
Teacher Management and Distribution	Inequitable distribution of teachers among schools	Teachers equitably distributed in all schools and regions	Ad hoc teachers distribution
School Establishment	Gradual increase in number of schools with limited control from the Government	Controlled establishment of new schools	Uncontrolled increase in numbers of schools
Population	Gradual increase in population leading to	Controlled population increase thus controlling	Uncontrolled population increase

Assumptions	Scenario Business as Usual	Best Case Scenario	Worst Case Scenario
	increase in secondary school enrolment	the demand for secondary school education	resulting to population explosion and in turn contributing to excessive demand for secondary school education
Number of Schools	Increasing trend	Controlled	Uncontrolled increase in number of schools
Economic Development	Unpredictable changes in economic growth	Consistent economic growth	Decline in Economic growth
Policy Change	Political influence in policy decisions regarding teacher recruitment and management	Effective policies based on research on teacher recruitment and management	Ad hoc policy changes on teacher recruitment and management

Business as Usual Scenario

The business as usual scenario tries to project secondary school teacher demand if the current trends are maintained into the future. The current trends are characterized unplanned teacher recruitment and limited teacher recruitment mainly to replace those leaving the profession through natural attrition. However, despite the limited teacher recruitment, there has been gradual increase in number of secondary schools and student enrolment putting more pressure on teacher demand. The rate of economic growth has not been predictable over the years characterised by weak economy which limited the capacity of the Government to employ more teachers. Although there is a teacher recruitment policy in place where teacher recruitment is expected to be demand driven, this policy has not been effective in solving the problem of teacher shortage in secondary schools.

Results from Poisson regression projection model for secondary school teachers indicates that if the teachers demand factors continues at the current trend, secondary school enrolment at the school level is likely to increase from 278 in 2007 to 731 in 2030. The numbers of teachers on duty at the school level are likely to increase from 13 in 2007 to 18 in 2030. The number of public secondary schools is likely to increase from 4489 in 2010 to 5992 in 2030.

Assuming the current teachers demand factors continue to increase at the current trends without any policy interventions, there will be a teacher shortage of 8 teachers at the school level and a teacher shortage of 79,901 at the national level in the year 2030. Thus teachers' shortage is likely to increase over the years if the current employment trends are perpetuated into the future. The increased future teacher shortage is likely to negatively affect the quality of teaching at the secondary school level which would in turn derail the projected achievements in view of Vision 2030 in the education sector.

The average class size is likely to reach 81 students by 2030, levels beyond the Ministry of Education recommended levels and far beyond the international standards if increase in enrolments as a results of the introduction of free secondary education is not accompanied by policy directions controlling the class size and encouraging introduction of more streams and building of more schools.

Table 25: Selected Factors and Teacher Demand Projections at the School Level Assuming the Current Trajectories

Year	No. of Schools	Teachers on Duty	Student Enrolment	PTR	Number of Classes	No of Streams	Average Class Size	Number Employed	Workload	Policy	Ln (Teacher Demand)	Teacher Shortage per school	National Teacher Shortage
2010	4489	13	331	25	8	2	41	2	22	0.5	1.7345	5.7	25455
2011	4565	13	352	27	8	2	44	2	22	0.5	1.7755	5.9	28247
2012	4648	18	371	21	9	3	41	2	22	0.5	1.5351	4.6	23201
2013	4719	18	391	22	9	3	43	2	22	0.5	1.5752	4.8	25516
2014	4793	18	411	32	9	3	46	2	22	0.5	1.6129	5.0	27941
2015	4868	18	431	42	9	3	48	2	22	0.5	1.6530	5.2	30533
2016	4944	18	451	52	9	4	50	2	22	0.5	1.5861	4.9	29947
2017	5018	18	471	62	9	4	52	2	22	0.5	1.6262	5.1	32632
2018	5093	18	491	72	9	4	55	2	22	0.5	1.6640	5.3	35497
2019	5168	18	511	82	9	4	57	2	22	0.5	1.7041	5.5	38549
2020	5243	18	531	93	9	4	59	2	22	0.5	1.7441	5.7	41796
2021	5318	18	551	13	9	4	61	2	22	0.5	1.7842	6.0	45318
2022	5393	18	571	23	9	4	63	2	22	0.5	1.8243	6.2	49055
2023	5468	18	591	33	9	4	66	2	22	0.5	1.8620	6.4	53015

Year	No. of Schools	Teachers on Duty	Student Enrolment	PTR	Number of Classes	No of Streams	Average Class Size	Number Employed	Workload	Policy	Ln (Teacher Demand)	Teacher Shortage per school	National Teacher Shortage
2024	5543	18	611	34	9	4	68	2	22	0.5	1.9021	6.7	57204
2025	5617	18	631	35	9	5	70	2	22	0.5	1.8353	6.3	55451
2026	5692	18	651	36	9	5	72	2	22	0.5	1.8753	6.5	59765
2027	5767	18	671	37	9	5	75	2	22	0.5	1.9131	6.8	64322
2028	5842	18	691	38	9	5	77	2	22	0.5	1.9532	7.1	69218
2029	5917	18	711	40	9	5	79	2	22	0.5	1.9932	7.3	74377
2030	5992	18	731	41	9	5	81	2	22	0.5	2.0333	7.6	79901

Table 26: Projections of Secondary School Teacher Shortage under Different Scenario

Year	S1 (Assuming Current Trends)	S2 (Worst Case Scenario)	S3 (Best Case Scenario)
2010	25455	25455	25455
2011	28247	28768	26493
2012	23201	27791	27791
2013	25516	33532	28083
2014	27941	36779	27227
2015	30533	40233	25138
2016	29947	40368	19765
2017	32632	48293	16971
2018	35497	55030	16872
2019	38549	73729	17522
2020	41796	94147	14678
2021	45318	99759	13203
2022	49055	106649	12728
2023	53015	110209	12253
2024	57204	113769	11778
2025	55451	105464	10303
2026	59765	108664	9828
2027	64322	111864	8353
2028	69218	115064	7878
2029	74377	118264	5403
2030	79901	126019	4928

Best Case Scenario

The assumptions held under best case scenario are that teacher recruitment would be based on actual demand at the school level. It is hope that under these scenario teachers will be equitably distributed and the problems of teacher shortages will be resolved. Teachers will be expected to be effectively and efficiently utilized ensuring that all teachers cover the optimum teaching workload. Thus the average teacher workload is expected to increase from the current 22 lessons per week to 27 lessons per week. Under this scenario, the population increase in the country is checked to avoid excessive demand for education. This would give room for planning of the expansion of the secondary school level education. The number of new secondary schools would be expected to be controlled by the Government based on secondary school student population. This would help reduce the number of under enrolled schools operating at sub-optimal levels. The economic growth is expected to be increasing gradually providing enough resources to allow employment of more teachers. To make this scenario a reality, the policy makers need to take bold steps, in not only formulating practical policies based on research, but also to see the effective implementation of those policies.

From the simulations of the most significant teacher demand factors using the teacher demand projection model developed in this study, it is projected that under the best case scenario, secondary school teacher shortage is likely to reduce from 25,455 in 2010 to 4,928 in 2030 (Table 26).

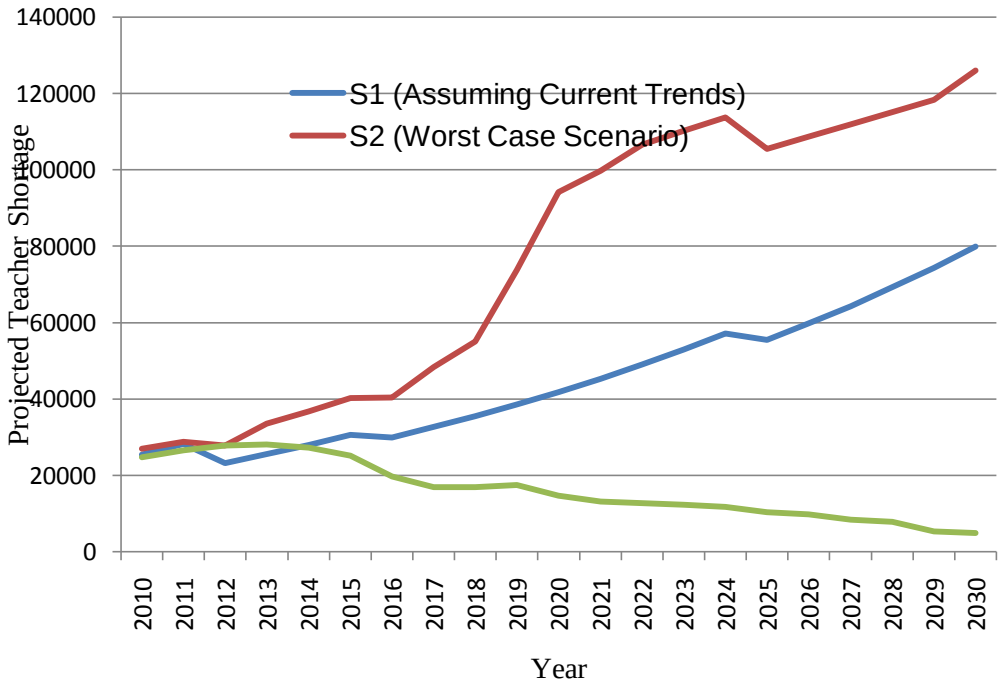

Figure 17: Projected Secondary School Teacher Shortages in Kenya 2010 - 2030

Worst Case Scenario

The assumptions held under worst case scenario are that there would be freezing of teacher employment by the Government. There would be uncontrolled population increase resulting in population explosion which would in turn result to excessive demand for secondary school level education and over enrolment in secondary schools in the country. There would also be uncontrolled establishment of secondary schools whereby while some schools would be over enrolled others would be under enrolled resulting in inefficient utilization of teachers. Under worst case scenario teacher management and distribution would not be planned contributing to inequitable teacher distribution and inefficient teacher utilization. Under this scenario, policy decisions related to teacher recruitment and management would be based on political and vested interests rather than being based on factual data.

Under worst case scenario it is projected that teacher shortage in secondary schools in Kenya is likely to increase from 25455 in 2010 to 126,019 in 2030 (Figure 17). This is a situation that would negatively affect the quality of education provision in education. Under such scenario it would be impossible for Kenya to attain the MDGs in education and Vision 2030 targets in education.

To avoid the Kenyan education system sliding into the worst case scenario in terms of teacher shortages, it is important for the policy makers and other stakeholders to review some of the policies relating to teacher recruitment and management with a view of making them more focused and practical. There would be the need to review policies to guide and control some of the factors affecting teacher demand including policies to control establishment of schools, teacher recruitment and management, private sector participation in provision of secondary education and economic development.

Thus in order to achieve the Vision 2030 secondary school teacher employment targets and to avoid the worst case scenario, the education sector will have to consider appropriate policy reforms in teacher recruitment, teacher management, teacher workload, establishment of new schools, class sizes and number of streams in a school.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents summary, conclusions and recommendations based on the evidence from the study. The chapter summarises national context of secondary school demand in Kenya, the methodology of the study and the key findings. The chapter also draws conclusions in response to the three research questions which set out to establish the factors affecting secondary school teacher demand as well as past trends and future projects of secondary school teacher demand and factors affecting it. The chapter also provides recommendations to address and further understand teacher demand issues in secondary schools in Kenya.

5.2 Summary

The purpose of this study was to establish the trends in the secondary school teachers demand factors and effects of the selected factors on the demand for trained secondary school teachers in Kenya. The study also aimed at developing a model that embraces a framework for projecting future secondary school teacher demand. This chapter contains summary, conclusions and the recommendations of the study.

The study had the following objectives:

1. Establish the trends of secondary school demand factors in Kenya between 1990 and 2007.
2. Determine the effects of selected factors on the demand for trained secondary school teachers in Kenya.
3. Develop a model for projecting future demand for trained secondary school teachers in Kenya.

The research design adopted in this study was cross-sectional research design using time series data. Data on selected factors and demand for secondary school teachers was collected for the period 1990 to 2007.

The population of this study included all the 4236 public secondary schools in Kenya in 2007, all graduate and diploma teachers who have been teaching in secondary schools in Kenya between 1990 and 2007 and sixteen Teacher Service Commission (TSC) provincial staffing officers. The study also targeted the TSC for records of all secondary schools in Kenya between 1990 and 2007.

Simple random sampling was used to select 351 secondary schools from the total of 4236 public secondary schools in the Kenya. The sample size of the schools was based on sample selection table by Kathuri and Palls (1992). Purposive sampling was used to select eight provincial staffing officers at the TSC Headquarters. Data for this study was collected by use of trained secondary school teacher demand proforma, secondary school demographic data proforma and provincial staffing officers interview schedule.

The data were analyzed by use of descriptive statistics, trend analysis and Poisson Regression. Diagnostic tests to check the suitability of the Poisson Regression were done using Dagostino Pearson test and Shapilo-wilk W test for normal data. The secondary school teacher demand model was developed based on Poisson Regression.
The key findings and conclusions of this study are based on the responses to the following research questions:

1. What are the trends of the secondary school demand factors in Kenya between 1990 and 2007?
2. What are the factors determining the demand for and secondary school teachers in Kenya?
3. What is the projected future demand for trained secondary school teachers in Kenya?

The study showed that the number of public secondary schools in Kenya had increased markedly between 1990 and 2007 and had been a major contributor to the associated increase in teacher demand. The average class size in public secondary schools in Kenya was 37 in 2007 and therefore below the optimum class size of 45 according to Ministry of Education recommedations. The public secondary school enrolment increased at a high rate of 90.8% from 618500 in 1990 to 1180300 in 2007. The study revealed that there are major regional disparities in student enrolment across the country with relatively large population of students in Central, Eastern, Nyanza, Rift Valley and Western Provinces. In contrast, there are low

student enrolments in North Eastern and Nairobi provinces. The number of teachers in public secondary schools in the country increased from 28056 in 1990 to 44305 in 2007 an increase of 58% over the period. The number of secondary school teachers on post varies by subject. The core subjects, including Mathematics, Kiswahili and English had the majority of the teachers followed by science subjects, while optional subjects have fewer numbers of teachers. The distribution of secondary school teachers on post by provinces shows that the secondary school teachers are not equitably distributed among all the provinces in the country. According to 2007 statistics 65% of the teachers are male while 35% are female. Thus the secondary school teaching profession in Kenya was male dominated. The study also established that the most secondary school teachers in Kenya were either aged or aging and therefore teacher retirement is likely to be a major determinant of secondary school teachers in Kenya.

The findings of this study showed that the significant factors determining secondary school teacher demand in Kenya included the number teachers on duty, secondary school enrolment, class size and number of newly employed teachers each year. The data collected provided evidence to prove that pupil teacher ratio, number of classes, number of streams, teacher workload and Government policy affect secondary school teacher demand collectively although they did not have significant effect of teacher demand independently.

The model for determining and projecting secondary school teacher demand in Kenya was developed in this study. The model equation as presented in Table 20 was:

$$Ln(y) = a + bx_1 + cx_2 + dx_3 + ... + \varepsilon \quad \text{Equation} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

was the most appropriate model for projecting secondary school teachers in Kenya.

where: y = teacher demand

a = Constant

x_1= Number of teachers on duty

x_2 = Student enrolment

x_3 = PTR

x_4 = Number of Classes

x_5 = Average class size

x_6 = Number of streams

x_7 = Number of teachers employed

x_8 = Average teacher workload

X_9 = Government policy

The results showed that most schools in Central, Nairobi and Eastern Provinces were overstaffed with Central province having the highest level of overstaffing while most schools in North Eastern, Western, Nyanza, Rift-valley and Coast provinces are understaffed with Rift Valley having the highest level of understaffing.

Results from Poisson regression projection model for secondary school teachers indicates that if the current teachers demand factors continue to change at the current trends without any policy interventions, there will be a teacher shortage of 8 teachers at the school level and 79,901 teacher shortage at the national level in the year 2030. Thus teachers' shortage is likely to increase over the years if the current employment trends are perpetuated into the future. The increased future teacher shortage is likely to negatively affect the quality of teaching at the secondary school level which would in turn derail the projected achievements in view of Vision 2030 in the education sector. The average class size is likely to reach 81 students by 2030, levels beyond the Ministry of Education recommended levels and far beyond the international standards if increased enrolments as a result of introduction of free secondary education is not accompanied by policy directions controlling the class size and encouraging introduction of more streams and building of more schools.

5.3 Conclusions

The conclusions of this study are derived from a review of the findings. The study concluded that the factors determining secondary school teacher demand in Kenya include: number teachers on duty, secondary school enrolment, class size and number of newly employed teachers each year.

The study developed the following model for projecting secondary school teacher demand in Kenya as presented by equation:

$$Ln(y) = a + bx_1 + cx_2 + dx_3 + ... + \varepsilon \quad \text{Equation } \ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

The study established that teacher demand factors have been changing over the study period thereby contributing to changes in secondary school teacher demand. The study also concluded that if the current teacher demand factors trends in public secondary schools are

maintained, there will be a shortage of eight teachers, on average, at the school level and a shortage of 79,901 teachers at the national level in 2030. Under the best case scenario whereby policy controls and intervention measures would control the teacher demand factors the teacher shortage would reduce to 4928 teachers by 2030. However, under the worst case scenario whereby the teacher demand factors get out of control, the teacher shortage at the secondary school level I Kenya would reach 126,019 by 2030.

5.4 Recommendations

This study lays out two sets of recommendations including options for addressing current and future teacher shortages and areas for further investigations.

5.4.1 Recommendations Addressing Teacher Shortages

5.4.1.1 The TSC and the Ministry of Education should make necessary policy reforms that would help improve teacher distribution and utilization.

5.4.1.2 The BOGs and the school administrators at the school level should work out ways to ensure that their schools have optimum class sizes and the teachers are efficiently utilized.

5.4.1.3 The Government should provide incentives to the private sector to play a greater role in the provision of secondary education in the country so as to relieve the pressure on public schools and the resultant teacher demand.

5.4.2 Recommendations for Further Studies

Although the study explored a lot of factors affecting teacher demand at the secondary school level, a comprehensive understanding of the interplay between the factors, teacher demand trends and other secondary school education issues would require investigations into the following:

5.4.2.1 The balance demand and supply of secondary school teachers in Kenya.

5.4.2.2 The effects of Teacher Shortages on quality of education in secondary schools in Kenya.

5.4.2.3 The effects of teacher shortages on teachers motivation

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APPENDICES

APPENDIX A: TRAINED SECONDARY SCHOOL TEACHERS DEMAND PROFOMA (1990 – 2007)

YEAR	Actual Demand	Employed	Deficit/Surplus
1990			
1991			
1992			
1993			
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002			
2003			
2004			
2005			
2006			
2007			

APPENDIX B: SECONDARY SCHOOLS DEMOGRAPHIC DATA 2007

School Name/ Number	Province	District	Total Student Population	Number of Classes	Number of Streams	Average Class Size	Number of Teachers on Duty	Number of Teachers Employed 2007	Average Teacher Workload
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

APPENDIX C: SECONDARY SCHOOL TEACHERS ATTRITION RATE PROFORMA (1990 – 2007)

Year/ cause of attrition	Death	Retirement	Dismissal	Resignation	Others	Total
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						

APPENDIX D: PROVINCIAL STAFFING OFFICERS' INTERVIEW SCHEDULE ON TEACHER RECRUITMENT, DEPLOYMENT AND NEED IN SECONDARY SCHOOLS IN KENYA.

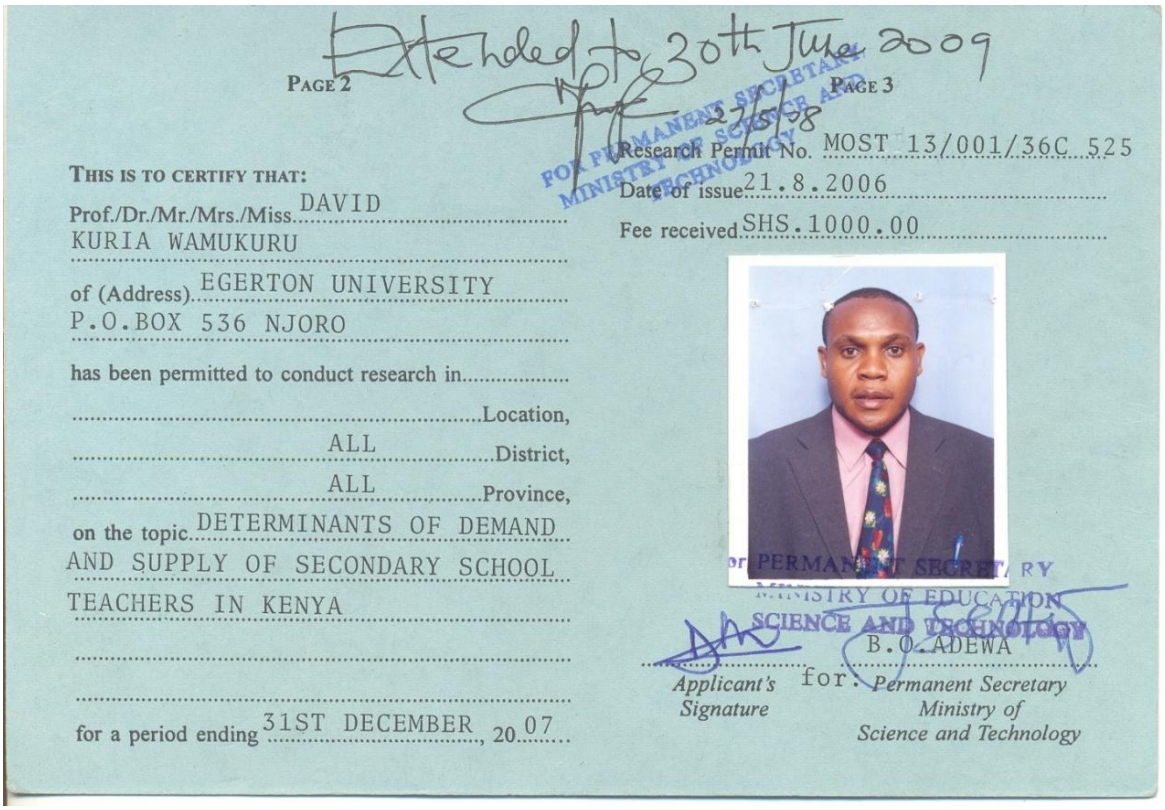
1. What is the TSC policy on employment of graduate teachers in Kenya?
2. What are the criteria currently used by the TSC to employ graduate teachers?
3. What is the TSC policy on transfer of graduate teachers?
4. What are the criteria currently used in the transfer of graduate teachers?
5. The following are some factors that affect teacher supply and demand. To what extent does each of them influence the current TSC staffing policy?
    - Teacher- student ratio
    - Student enrolment
    - Class size
    - Number of lessons per teacher per subject
    - Vacancies in the schools
    - Teachers salary
    - Ability of the Government to pay teachers salaries
    - Location of the school
    - Influence of the Headteacher/ BOG
    - Teacher attrition due to:
        - retirement
        - deaths
        - teacher dismissal
        - resignation
        - health related withdrawal
6. How have the following factors of staffing changed since 1990
    - Teacher- student ratio
    - Student enrolment
    - Class size
    - Number of lessons per teacher per subject
    - Vacancies in the schools
    - Teachers salary
    - Ability of the Government to pay teachers salaries
    - Location of the school
    - Influence of the Headteacher/ BOG
    - Teacher attrition due to:
        - retirement
        - deaths
        - teacher dismissal
        - resignation
        - health related withdrawal

7. What are your comments on the situation on teacher staffing:
    - Staffing norms
    - Staff composition (by subject and gender – factors influencing)
    - Staffing gap by subject
    - Coping with staffing gap

- Teaching load
- Situation of teacher demand and supply in public and private schools
- Teacher recruitment
- Other staffing issues and factors:
    a. Enrolment
    b. Class size
    c. Regional differences
    d. Redeployment and deployment of teachers
- Any other staffing issue

8. What are the projected trends future TSC policy on the following factors and aspects of staffing of secondary schools?
    - Teacher- student ratio
    - Student enrolment
    - Class size
    - Number of lessons per teacher per subject
    - Vacancies in the schools
    - Teachers salary
    - Ability of the Government to pay teachers salaries
    - Location of the school
    - Influence of the Head teacher/ BOG
    - Teacher attrition due to:
        a. retirement
        b. deaths
        c. teacher dismissal
        d. resignation
        e. health related withdrawal
9. What other factors, in your opinion, will be instrumental in guiding the future staffing levels of graduate teachers in Kenya/your province?

APPENDIX E: COPY OF RESEARCH PERMIT



Extended to 30th June 2009

PAGE 2

THIS IS TO CERTIFY THAT:

Prof./Dr./Mr./Mrs./Miss. DAVID KURIA WAMUKURU

of (Address) EGERTON UNIVERSITY P.O.BOX 536 NJORO

has been permitted to conduct research in

..... Location,

ALL ..... District,

ALL ..... Province,

on the topic DETERMINANTS OF DEMAND AND SUPPLY OF SECONDARY SCHOOL TEACHERS IN KENYA

for a period ending 31ST DECEMBER, 2007

Applicant's Signature

PAGE 3

Research Permit No. MOST 13/001/36C 525

Date of issue 21.8.2006

Fee received SHS.1000.00

FOR PERMANENT SECRETARY MINISTRY OF EDUCATION SCIENCE AND TECHNOLOGY

for: B.O.ADEWA

Permanent Secretary
Ministry of
Science and Technology

APPENDIX F: COPY OF RESEARCH AUTHORIZATION CERTIFICATE

MINISTRY OF SCIENCE & TECHNOLOGY

Telegrams: "SCIENCE TEC", Nairobi

Fax No.
Telephone No: 318581
When replying please quote
MOS&T 13/001/36C 525/2

REPUBLIC OF KENYA

JOGOO HOUSE "B"
HARAMBEE AVENUE
P.O. Box 60209-00200
NAIROBI
KENYA

22nd August 2006

Extended to
30th June 2009
27/6/8

David Kuria Wamukuru
Egerton University
P.O. Box 536
NJORO

Dear Sir

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***'Determinants of Demand and Supply of Secondary School Teachers in Kenya:***

I am pleased to inform you that you have been authorized to carry out research in **all** Districts in Kenya and for a period ending 31st December 2007.

You are advised to report to the District Commissioners and District Education Officers of the Districts you will visit before commencing your research project.

On completion of your research you are expected to deposit two copies of your research findings to this office.

Yours faithfully

B. O. ADEWA
FOR: PERMANENT SECRETARY
Copy to:

The District Commissioners

The District Education Officers

APPENDIX G: LETTER OF RESEARCH AUTHORIZATION FROM TSC

TEACHERS SERVICE COMMISSION

Telephone: Nairobi 312067, 312068, 312078, 312089, 312091, 312093, 312096, 312132, 312145
Telegrams: "MWALIMU". Nairobi
When replying please quote.

Ref. No.
TSC/DS (ADMIN)/RESE/AUTH./6

THE BAZAAR
MOI AVENUE/BIASHARA STREET
PRIVATE BAG
NAIROBI,

28TH MAY, 2008

To
David Kuria Wamukuru
Egerton University
P.O.Box 536
NAKURU

RE: RESEARCH AUTHORIZATION

Please refer to your letter of Authorization to carry out research by the Ministry of Science and Technology dated 22nd August, 2006.

In your letter of 26th May, 2008 you asked the Commission to allow you to carry out research within the Teachers Service Commission on your topic of research " Determinants of Demand and supply of Secondary School Teachers in Kenya", a Case Study of Teachers Service Commission.

You are hereby authorized to carry out the research.

The Commission would need to obtain a copy of your research finding when you are through.

PETER L. OLE SHONKO
FOR: SECRETARY
TEACHERS SERVICE COMMISSION